AN INVESTIGATION OF POTENTIAL POLLUTION OF GODS LAKE BY LEACHATE FROM AN ABANDONED GOLD MINE

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ABSTRACT

A study investigating potential pollution of Gods Lake by leachate emanating from an abandoned gold mine was conducted in 1981. Water, sediment and biota samples from three areas of Gods Lake were analyzed. Elevated levels of metals were discovered in lake sediments and macrobenthic organisms occurring in the vicinity of the abandoned tailings disposal site. Evidence of contamination of the water column or of elevated metal levels in fish of the area was not detected.

SUMMARY

During the period 1935 to 1943, Gods Lake Gold Mines Limited mined and processed 490,812 tonnes of ore on Elk Island of Gods Lake. Operational wastes were discarded to an adjacent tailings disposal site. Concerns respecting possible pollution of Gods Lake by metal and acid leachate emanating from the tailings disposal site prompted a study in June, 1981.

Three sites were selected for the study; the Elk Island bay adjacent to the tailings disposal site, an area near the lake outlet which served as a downstream comparison, and the influent area of the south basin which served as the control. Water samples collected randomly from each site were analyzed for sixteen physicochemical parameters and nine metals. Sediments, macrobenthic shoreline invertebrates and representative fish samples from each site were analyzed for seven metals. Where possible, site data were compared statistically.

It was determined that leachate emanating from the tailings disposal area had indeed resulted in elevated sediment metal concentrations within an area of approximately 0.25 square kilometres of lake surface southwesterly adjacent to the disposal site. Mercury, arsenic, copper, lead, nickel, zinc and iron concentrations were observed to increase exponentially in lake sediments as the mouth of the major stream draining the tailings disposal site was approached. A similar relationship with cadmium, manganese and cyanide concentrations was not evident. Mercury, arsenic, cadmium, lead and zinc were found to have accumulated at levels greater than background in the body tissues of macroinvertebrates

colonizing the affected area. Bioaccumulation of metals by fish and contamination of the water column from leachate of the disposal area was not detected in this study.

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INTRODUCTION

A gold mine and mill complex were operated on Elk Island at Gods Lake (54° 40', 94° 09') from 1935 to 1943. A total of 490,812 tonnes of ore were milled, producing 4,552 kilograms of gold and 805 kilograms of silver (Mineral Department Sector, 1962). The milling operation consisted of a blanket cyanidation treatment during which mercury was utilized in the amalgamation process.

Concerns have recently been expressed regarding possible heavy metal leaching and acid drainage from abandoned mill tailings. Accordingly, Water Standards and Studies conducted a baseline study of the area during June 9-17, 1981. The primary objectives of the study were as follows:

1.) To determine whether heavy metals were being leached and/or low pH waters were draining from the tailings disposal area to Gods Lake;

2.) To determine the extent of metal uptake by local aquatic fauna.

AREA DESCRIPTION

Physiographically, the study area lies within the Precambrian Drift Plain subregion. As such, the predominantly granitic bedrock is overlain by varying thicknesses of glacial drift (Weir, 1960). The topography is gentle to rolling with frequent rock outcrops. Peat deposits and various podzols are the dominant soil types encountered. Vegetation of the area is dominated by climax black spruce forest, with jackpine - aspen communities in varying stages of development on the numerous burn sites. Mixed broadleaf communities of aspen, birch, black poplar and willow are common along the south basin of Gods Lake.

Gods Lake lies approximately 550 kilometres north-northeast of Winnipeg and is accessible by air and winter road (Figure 1). It is one of Manitoba's larger northern lakes, with a surface area of some 1050 square kilometres. Gods Lake is essentially divided into two basins, a smaller, shallower, southern basin and a larger, deeper, northern basin. Schlick (1978) has reported a mean depth of 13.2 metres for the lake, with maximum depths of 74.3 and 21.3 metres, respectively, for the northern and southern basins. At its outflow to Gods River, the lake receives drainage from a watershed of approximately 27,200 square kilometres (Fedoruk, 1970).

Sampling block "A" (Figure 2) straddled the Kanuchuan River inlet arm of the southern basin. Bedrock in the area consists of undifferentiated granites. Moderately sloped outcrops are common along the shoreline. The shoreline, however, is dominated by boulders of glacial drift origin. Sand beaches occur only occasionally. Water depths increase very gradually from

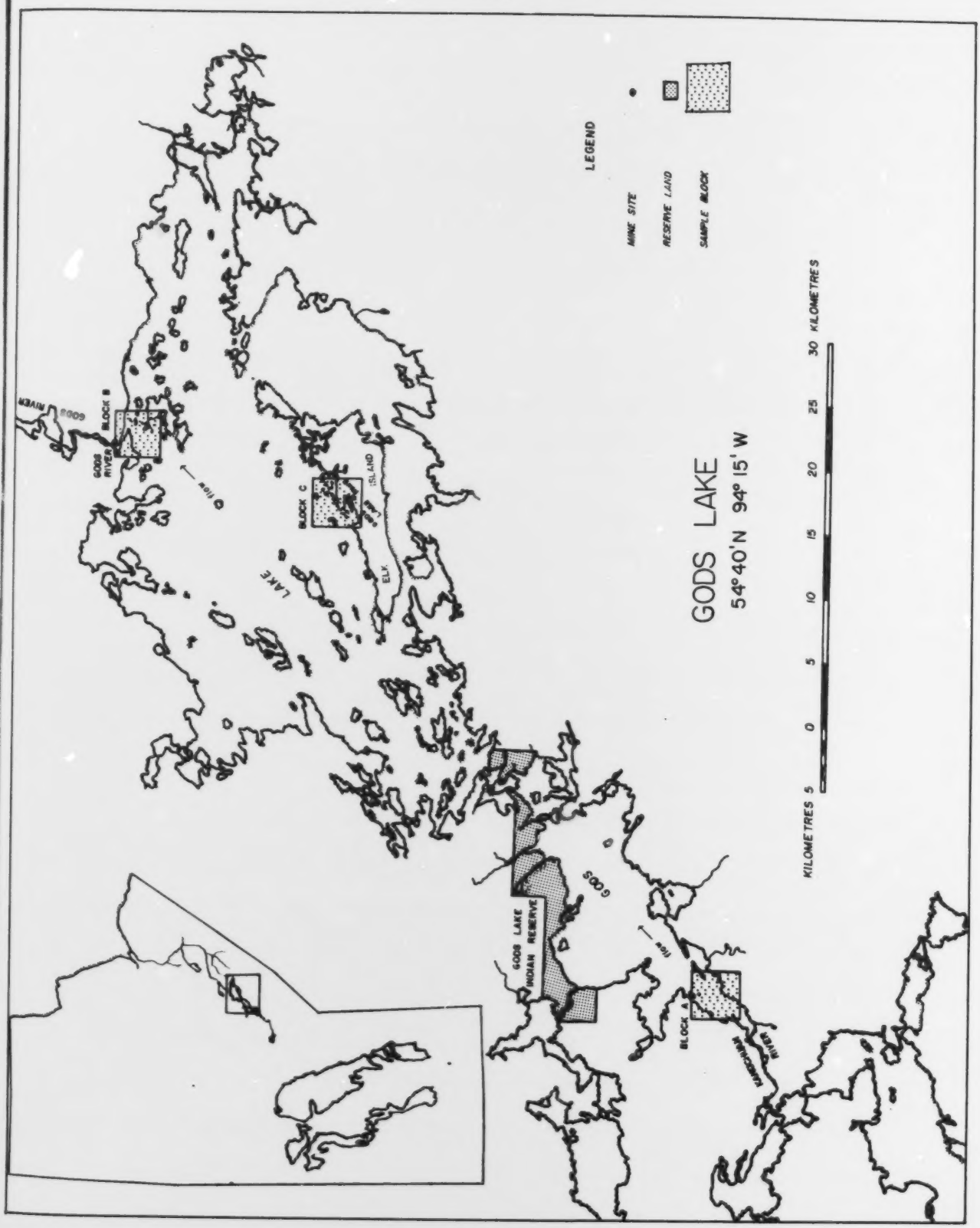

FIGURE I. LOCATIONS OF SAMPLING BLOCKS ON GODS LAKE.

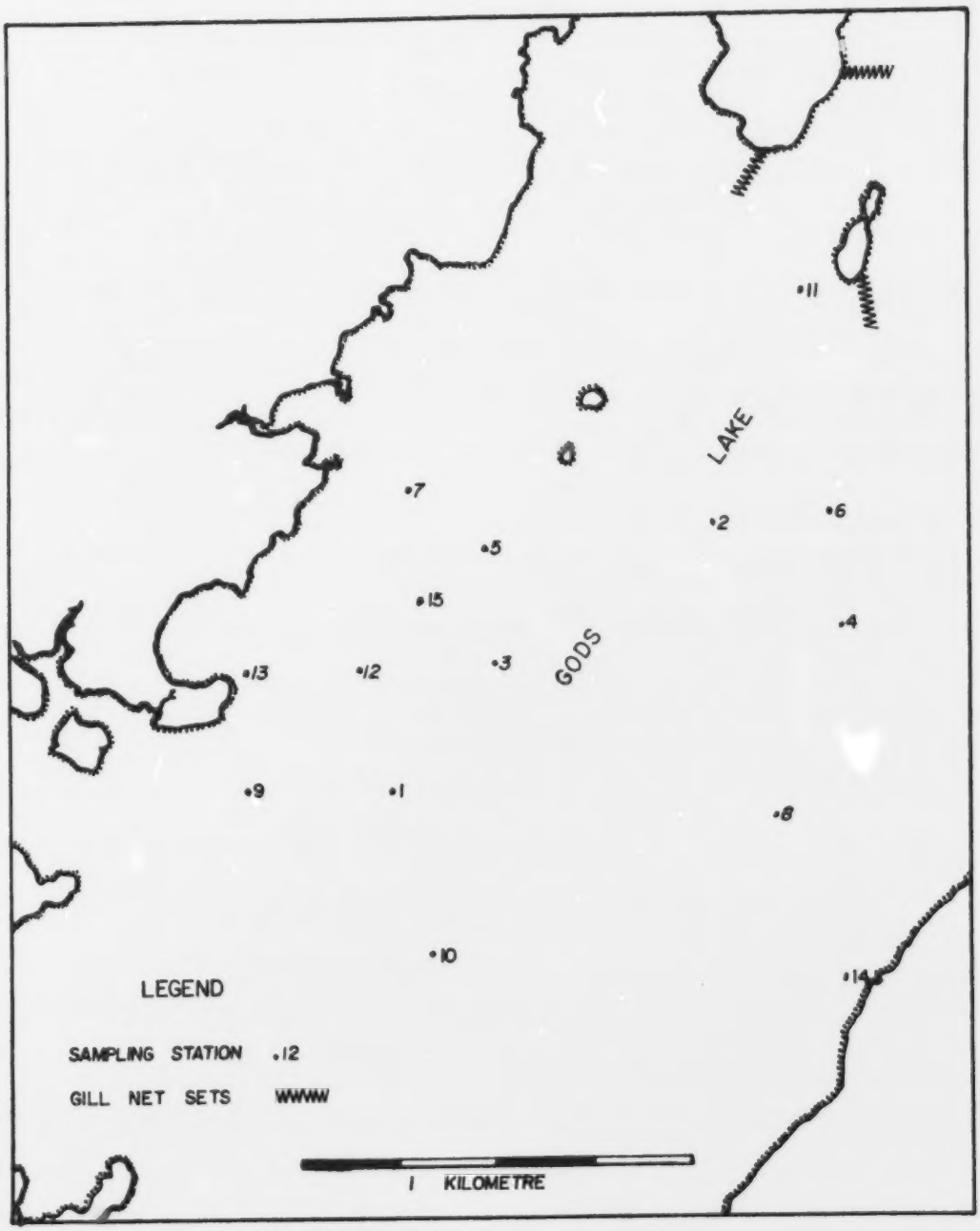

FIGURE 2. GODS LAKE BLOCK A

the shoreline to a maximum of 7.75 metres within block "A". Bottom materials encountered within this area are predominantly fine, grey silts.

Sampling block "B" (Figure 3) was westerly adjacent to the mouth of Gods River. Moderately sloped volcanic outcrops dominate the shoreline at this site (Davies et al, 1962). Pebble and cobble beaches are also common. Water depths increased unevenly from the shoreline to a maximum of 9.5 metres. Reefs are numerous. Bottom types are not uniform, ranging from rock to gravel to fine silts.

Block "C" (Figure 4) was adjacent to the abandoned mine and mill tailings site on Elk Island. The shoreline slopes steeply and consists almost exclusively of mafic and ultramafic intrusions to the surrounding volcanic rocks (Davies et al, 1962). Water depths also increase steeply to a maximum of 25.6 metres. Bottom types vary considerably from weathered rubble at the base of cliffs to bare rock on submerged reefs to fine silt beds lying between rises in the lake floor.

Two communities are located on Gods Lake, one at the narrows and the other at the outlet to Gods River, The local economy is based largely on the renewable resource commodities derived from commercial fishing and trapping. Additionally, considerable monies are generated by four local fishing lodges; Gods Lake, Elk Island Lodge (Elk Island), Stringers Gods Lake Narrows Lodge (the Narrows), Tomalty's Gods Lake Lodge (east end) and Gods River Lodge (lake outlet).

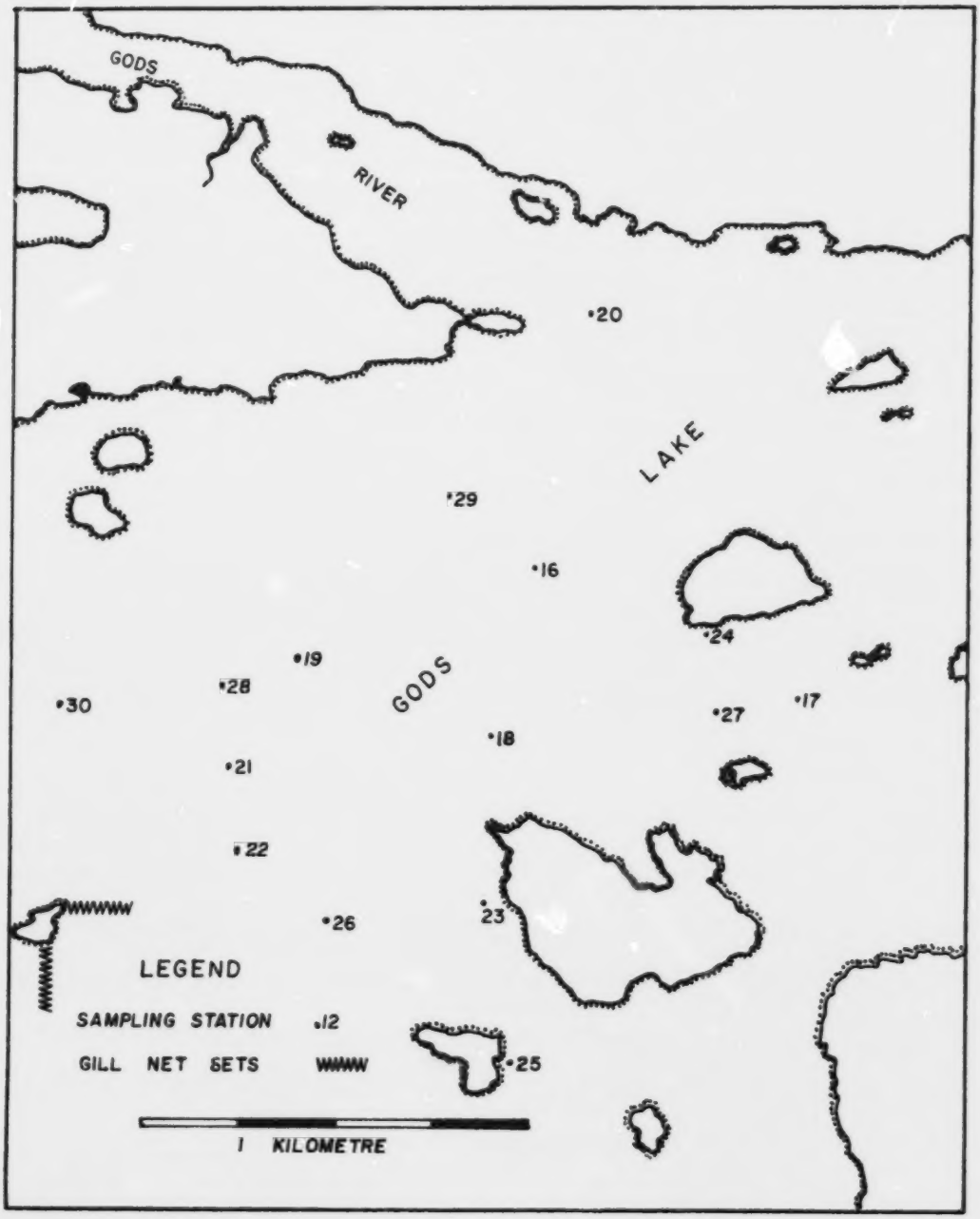

FIGURE 3. GODS LAKE BLOCK B

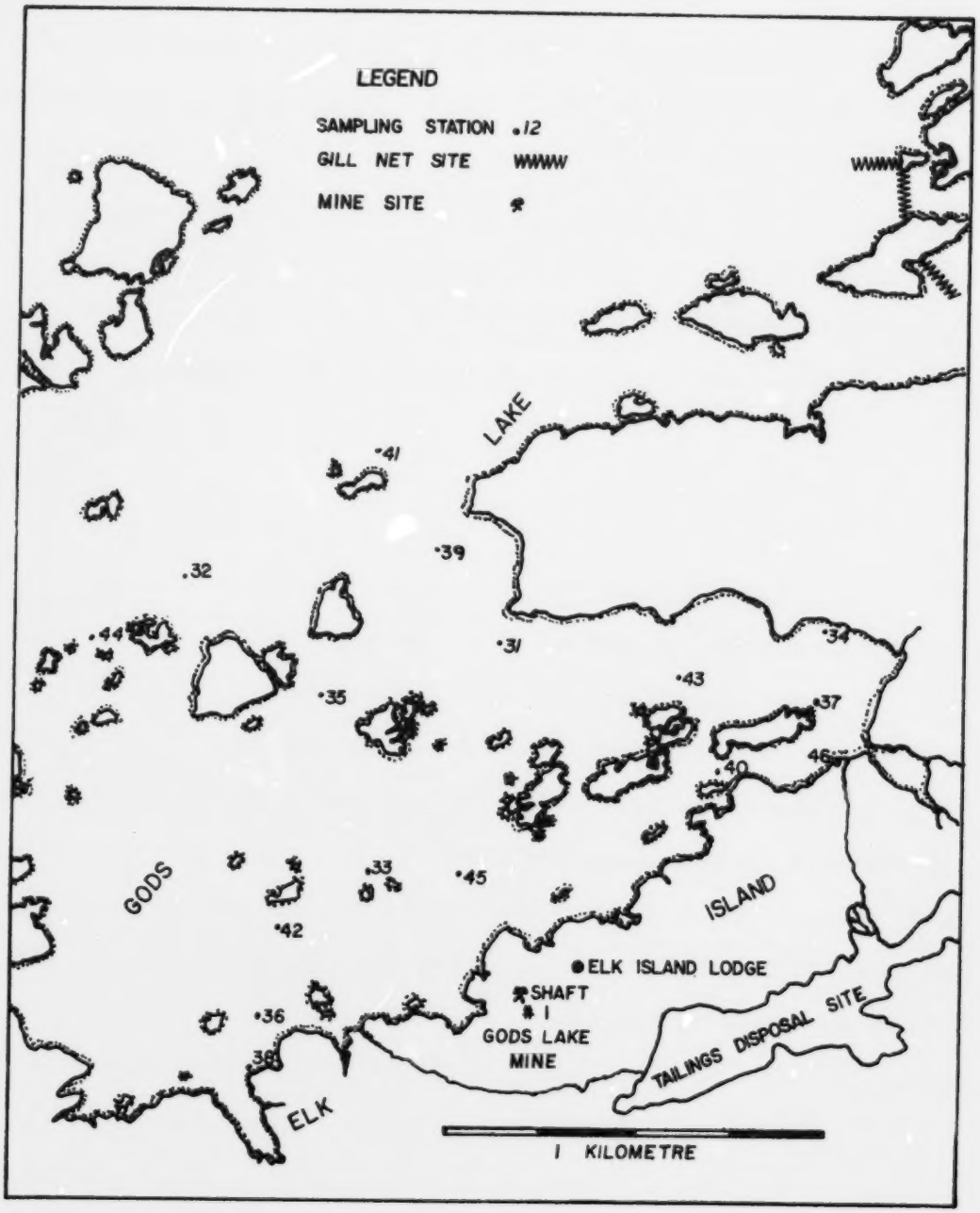

FIGURE 4. GODS LAKE BLOCK C

SUMMARY OF MINE AND MILL OPERATIONS*

The original gold discovery was made at Jowsey Island (9.5 kilometres west of Gods Lake Gold Mine) in mid 1932. Subsequent exploration and staking led to the incorporation of Gods Lake Gold Mines Limited for development of the holdings. Preliminary development, including the sinking of Shaft No. 1 was begun in 1933. Ore reserves to the end of 1934 were calculated to be 68,900 tonnes averaging 13.5 g/ tonne gold. Production was planned for 1935 and construction of the Kanuchuan Rapids hydro electric dam begun in order to supply the mine site with electrical power. Construction of a cyanide treatment mill was also begun at this time.

The ore body consisted of highly fractured tuff cemented by gold and sulphide bearing quartz veins and lenses. Free gold was reported conspicuous in places. Pyrrhotite was the predominant sulphide, but with it was a considerable amount of pyrite and a little chalcopyrite and sphalerite. Galena and arsenopyrite were reportedly rare.

The mine and mill operated from September 1935 until exhaustion of the ore reserves in September 1943. During the life of the operation, a total of 490,812 tonnes of ore were milled, producing 4,552 kilograms of gold and 805 kilograms of silver. The property is currently held by Lakelyn Mines Limited.

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*Summarized from Mineral Development Sector, 1962.

STUDY METHODS AND MATERIALS

Study Design

Three sampling blocks were selected for the purposes of the study. The influent area of Gods Lake, Block "A" (Figure 2), was selected as the control. The exit to the lake, Block "B" (Figure 3), was considered representative of cumulatively impacted areas downstream of the potential tailings drainage path. The area immediately adjacent to the mine and mill tailings disposal site was designated Block "C" (Figure 4) and considered likely to be most adversely affected.

A total of fifteen sampling stations per block were randomly identified. This was accomplished by superimposing a numbered grid upon diagrams of each block and utilizing random number tables (Rand Corp., 1955) to determine grid reference points.

Field Procedures

Transportation to and from the study area was via regularly scheduled DC-3 service flights to the lake's communities. Transportation about the lake was by two outboard motor boats rented from a local fishing lodge. Collection of perishable samples was arranged so that advantage could be taken of the regularly scheduled twice weekly flights from Gods Lake Narrows to Winnipeg. Technical Services Laboratory receipt of these samples was thus assured within twenty-four hours of collection

A four litre acrylic Kemmerer sampler was used to collect water at random depths from each of the randomly identified stations. Random depths were determined by considering random numbers (Rand Corp., 1955) as a percentage of the total depth of each station. Volumes collected were

sufficient for laboratory analysis of the requested eleven physico-chemical parameters, nine metals and three nutrients as well as free and total cyanides.* Water temperatures were measured and recorded on site. All water samples were shipped so as to assure receipt by analytical staff at Winnipeg within twenty-four hours of collection.

Original intentions to sample sediments with an impact coring device proved impractical due to insufficient compaction of sedimented materials. Instead, sediments from each station were collected by using a 22.9 centimetre square Ekman dredge. Upon hoisting the Ekman grab to the lake surface, the top of the dredge was carefully opened so as to not disturb the delicate water-sediment interface. A five centimetre diameter clear acrylic tube was then inserted through the dredge contents. Excess water and sediments more than five centimetres below the interface were carefully drained from the pipe. The remainder of the sample was placed in a labelled whirlpac plastic bag. Duplicate samples collected in a like manner were taken from every fifth station per sampling block. Sampling of sediments was conducted in conjunction with that of water in order to ensure shipment and receipt by analytical staff within twenty-four hours of collection. Accompanying the sediment samples were analytical requests for nine metals** and both free and total cyanides.

Fish were collected by deploying overnight gangs of 95.3 and 108 mm. mesh gill nets at suitable locations within each sampling block (Figures 2, 3 and 4).*** The total catch per block was identified to species

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* Parameters listed in Table 1

** Parameters listed in Table 2

*** Nets were set approximately 1.25 kilometres beyond the confines of block "C" so as to minimize interference with heavy boat traffic emanating from Elk Island Lodge. The proximity, however, was thought adequate to ensure collection of fish frequenting block "C".

and tallied. A maximum of twenty individuals per species per block, each representative of the size range of walleye, northern pike, common sucker, longnose sucker and lake whitefish collected, were then selected for sampling. Each individual was assigned a unique identifying number, weighed to the nearest 10 grams, measured to the nearest 0.1 centimetre and sexed. Evidences of age, consisting of either otoliths, cleithra, dorsal spines and/or pelvic fin rays (species dependent), were removed at this time. Specimens were then filleted and the lateral muscle tissue inserted in labelled whirlpac plastic bags. Muscle tissue samples were shipped to anlaytical staff within forty-eight hours of collection and were accompanied by analytical requests for seven metals.*

Boulder shorelines within each block were scoured for aquatic invertebrates. Samples from each block were placed in labelled whirlpacs and shipped to the Technical Services Laboratory for analysis of seven metals.**

The tailings disposal site (Figure 11) was searched for evidence of surface runoff to Gods Lake. The locations of effluent drainage were documented. Additionally, five samples of tailings were taken from various locations on the tailings pile. All samples were shipped to the Laboratory within twenty-four hours of collection. Analyses requested were identical to that of regular sediments.

Analytical Procedures

Upon receipt by the Technical Services Laboratory, all water, tailings and duplicate sediment samples were refrigerated. The remaining sediments and all biological samples were placed in freezers. All samples were analyzed prior to shelf life expiration according to methods described

* Parameters listed in Table 4.
** Parameters listed in Table 7.

by Sorba et al (1980).

Fish evidence of age were submitted for age determination to Mr. H. Metheringham of the Department of Natural Resources, Biological Services Branch.

Upon completion of analyses, all data were tabulated and summarized. Analysis of variance was performed on water and sediment chemical parameters. Regressions of block "C" $\mu g/g$ of each metal on estimated direct water distance (km) from the major tailings stream mouth (Station 46, Figure 4) were also calculated. Isopleths of metal concentrations were prepared for significant regressions. Regressions of $\mu g/g$ of each consistently detectable metal in fish muscle tissue on weight were calculated and metal concentrations estimated for four equidistant weights of a range common to each series of samples per species. Analyses of variance were then conducted on both observed and estimated values in order to provide comparisons between sampling blocks.

RESULTS AND DISCUSSION

Water Physicochemistry

Water physicochemistry data are detailed in Appendices 1a to 1c and are summarized in Table 1. The analysis of variance results are also presented in Table 1.

Water temperatures were remarkably uniform within each sampling block. This uniformity appears to have been generated by strong winds at block "A", the occurrence of vernal overturn at block "C" and a combination of these two factors at block "B". Due to its smaller size and shallower depth, hence lesser volume, the southern basin had apparently been free of ice for a greater length of time than had the northern basin. Thus block "A" waters at 11°C were relatively warm. As indicated by the 8°C temperature, the relatively shallow outlet area (block "B") had apparently recently undergone vernal overturn and subsequent warming during vigorous wind action. The presence of small ice floes on June 10, 1981 and near uniform temperatures of 5°C six days later indicates that the vernal overturn had just been completed at block "C". The single instance of temperature nonconformity (8°C) was observed at station 37 (Figure 4), a shallow site well protected from wind action. The significance of wind action upon the thermal regime of Gods Lake must not be underestimated as Schlick (1978) reports that summer thermoclines developed sporadically and were frequently destabilized by winds.

Dissolved oxygen concentrations further indicated the occurrence of near complete mixing at the time of the study as concentrations were relatively uniform within each sampling block. Block "A" concentrations

TABLE 1: SUMMARIZATION AND ANALYSIS OF VARIANCE OF WATER PHYSICOCHEMICAL DATA, GODS LAKE, 1981.

Sampling Block / Parameter \ Statistic		"A" Kanuchuan River Area				"B" Gods River Area				"C" Elk Island Area				Nova		
		$\bar{x}$	δ	Hi	Lo	$\bar{x}$	δ	Hi	Lo		δ	Hi	Lo	F	d.f	F.95
Field Temperature	oC	11.0	0	11.0	11.0	8.0	0	8.0	8.0	5.2	0.77	8.0	5.0	-	-	-
Conductivity	mho/cm	134	2.22	137	129	127	1.29	129.	125.	127	1.10	128	125	84.00	2,42	3.22
Residue Non Filt.	mg/l	<5.0	0.0	<5.0	<5.0	<5.07	0.26	6.0	<5.0	<5.0	0.0	<5.0	<5.0	1.00	2,42	3.22
pH (Logarithmic mean expressed)	Units	7.88	-	8.00	7.80	8.03	-	8.20	7.	7.91	-	8.05	7.80	-	-	-
Alkalinity Total ($CaCO_3$)	mg/l	58.62	4.01	73.	57.0	61.50	0.50	62.0	61.	62.90	0.71	64.5	61.5	12.73	2,42	3.22
Alkalinity (HCO_3)	mg/l	71.51	4.92	89.1	69.2	74.80	0.86	76.0	73	76.80	0.94	79	75.0	12.42	2,42	3.22
Alkalinity (CO_3)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	2,42	3.22
Alkalinity (OH)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	2,42	3.22
As (Total)	mg/l	0.0013	0.0010	0.005	<0.001	<0.001	0.0	<0.001	<0.001	0.0011	0.000	0.002	<0.001	0.76	2,42	3.22
Cd (Ext)	mg/l	<0.005	0.0	<0.005	<0.005	<0.005	0.0	<0.005	<0.005	<0.005	0.0	<0.005	<0.005	0.00	2,42	3.22
Cu (Ext)	mg/l	0.035	0.0247	.095	.010	0.025	0.0200	0.075	0.005	0.024	0.0151	0.045	0.015	1.43	2,42	3.22
Pb (Ext)	mg/l	0.0057	0.001	0.010	<0.005	0.0053	0.001	0.010	<0.005	0.0	0.0	0.005	<0.005	1.05	2,42	3.22
Ni (Ext)	mg/l	<0.005	0.0	0.005	<0.005	0.005	0.0	0.005	<0.005	0.005	0.0	0.005	<0.005	0.00	2,42	3.22
Zn (Total Dir.)	mg/l	0.028	0.019	0.09	<0.02	0.021	0.0026	0.03	<0.002	0.029	0.026	0.03	0.02	2.16	2,42	3.22
Hg (Ext)	µg/l	0.105	0.3033	1.20	<0.02	0.039	0.0454	0.18	<0.02	<0.02	0.0	<0.02	<0.02	0.94	2,42	3.22
Ca (Ext)	mg/l	10.13	0.52	12.0	10.0	12.67	1.54	15.	10.	14.20	1.26	17	13.0	44.68	2,42	3.22
Mg (Ext)	mg/l	4.21	0.23	5.0	4.0	4.27	0.059	4.3	4.1	4.42	0.166	5.0	4.3	0.14	2,42	3.22
Dissolved Oxygen	mg/l	9.94	0.06	10.0	9.80	11.66	0.27	11.9	11.1	11.61	0.28	12.0	11.0	259.21	2,41	3.23
T.O.C.	mg/l	10.53	0.52	11.5	10.0	11.87	1.98	17.0	10.0	10.10	0.85	12.0	9.0	7.79	2,42	3.22
T.I.C.	mg/l	12.93	0.32	13.5	12.5	13.57	0.26	14.0	13.0	14.07	1.27	16.5	11.5	8.20	2,42	3.22
Turbidity	NTu	2.27	0.26	2.5	2.0	1.25	0.27	1.50	0.85	1.07	0.28	1.50	0.75	84.28	2,42	3.22
CN (Total) + (Free)	mg/l	<0.02	0.0	<0.02	<0.02	<0.02	0.0	<0.02	<0.02	<0.02	0.0	<0.02	<0.02	0.00	2,42	3.22
Kjeldhal Total-N	mg/l	0.30	0.0	0.3	0.3	0.29	0.026	0.3	0.2	0.31	0.0026	0.4	0.3	1.50	2,42	3.22
$NO_3 - NO_2$- N (Diss.)	mg/l	0.013	0.0090	0.04	<0.01	0.011	0.0026	0.02	<0.01	0.026	.0463	0.19	<0.01	1.36	2,42	3.22
P - Total	mg/l	0.022	0.0041	0.03	0.02	0.021	0.0026	0.03	0.02	0.020	.0120	.05	0.01	0.28	2.42	3.22

averaged 9.94 mg/l, representing a 90.4% level of saturation. Though mean dissolved oxygen concentrations at blocks "B" and "C" (11.66 and 11.61 mg/l respectively) were significantly greater than those of "A", saturation levels at block "C" (91.2%) were more similar to that of "A" whereas block "B" levels (97.4%) approached total saturation.

Turbidity, like dissolved oxygen and temperature, also served to distinguish between the two basins of Gods Lake. Block "A" turbidities (mean 2.7 NT units) were approximately twice those of blocks "B" and "C" (means of 1.27 and 1.05 NT units, respectively). It appeared that these differences may have resulted at least partly from discoloration from tannic acids leached to the southern basin from surrounding areas of bog. A minor variation in color would help explain the 1.3 m difference in mean secchi depths between the basins as recorded by Schlick (1978). Wind action was apparently not a major factor in the 1981 study as non filterable residues were below detection limits at all sampling blocks; a condition indicating that fine surficial sediments had not been dislocated from the lake floor. However, wind action may have caused the single instance of non filterable residue detected (6.0 mg/l, at station 16). Invertebrate exuvia and/or other organic detritus may have been washed from a reef near the station, affecting both the residue value and causing the highest total organic carbon value (17.0 mg/l) recorded during the study.

Values for pH were observed to fall within the upper limits of the range reported by Schlick (1978). Logarithmic means of the 1981 values varied only slightly from 7.88 (block "A") to 8.03 pH units (block "B"). Total and bicarbonate alkalinities both showed slight increases from blocks

"A" through "C". Means were lowest in the south basin (58.62 and 71.51 mg/l, respectively), and highest near Elk Island (62.9 and 76.80 mg/g respectively). Though analysis of variance indicated significant differences between means, data from both blocks "B" and "C" fell within the range of block "A" data. It is probable that the differing means were merely indicative of the surrounding geological formations. In any event, neither pH nor alkalinities offer evidence that acid drainage from the tailings disposal site is impacting upon the waters of block "C".

Mean conductivities evinced significant differences between the two lake basins. Block "A" conductivities averaged 134 µmho/cm whereas both north basin sampling blocks averaged 127 µmho/cm. However, because of the unit range, the difference was considered of minor consequence.

Concern regarding possible metal contamination emanating from the tailings disposal site was the primary motivation behind initiating this study and therefore the determination of metal concentrations in the water column was consequently a major objective. It was therefore interesting to note that no evidence of water column contamination by the seven metals of concern was observed. Block "C" mean concentrations of arsenic, cadmium, copper, lead, nickel, zinc and mercury were either less than or equal to those of blocks "A" and "B". Individual highest concentrations for arsenic (0.005 mg/l), copper (0.095 mg/l), lead (0.010 mg/l), zinc (0.09 mg/l and mercury (1.20 µg/l) were all encountered at various block "A" stations. Cadmium was not detected in any samples and nickel was present only in minimally detectable (0.005 mg/l) quantities. Among the metals, only extractable calcium showed significantly elevated levels in the vicinity of

of Elk Island. However, both calcium and magnesium likely reflect the greater frequency of carbonate ions at this site rather than contamination from the tailings disposal area. Apparently, neither of these metals occurs in significant amounts in the minerals composing the ore body and the surrounding rock so as to warrant this increase. (Fairbridge, 1972).

Cyanide, the compound used in the gold extraction process, was not detected in any of the water samples. As cyanide readily complexes with metallic ions and becomes sedimented, it is not sufficiently stable to pose a water column contamination risk at the Elk Island site.

Mean total nitrogen and phosphorus concentrations were relatively low, fluctuating narrowly about 0.30 and 0.02 mg/l respectively. Mean nitrate-nitrite forms of nitrogen showed somewhat more variation due to an apparent anomaly at station 37 (0.19 mg/l). Exclusion of the anomaly by the Dickson's outlier test yielded mean nitrate-nitrite concentrations which fluctuated very narrowly about the 0.01 mg/l level. All nutrient parameter means were consistent with Vollenweiders (1968) criteria for oligotrophic status and showed no significant differences between sampling blocks.

Sediments

Sediment metal and cyanide data are detailed in Appendices 2a to 2c. These data have been summarized and are presented in Table 2 along with analysis of variance results. Regressions of metal and cyanide concentrations ($\mu g/g$) on distance (km) from the mouth of the major stream draining the tailings disposal site are presented in Table 3.

Prior to discussion of the sediment data, it is expedient to rationalize the nature of regression analyses performed on block "C" data.

Until "C" site was inspected by the study crew, it was not apparent that discharges from the major stream draining the tailings disposal site were distributed normally throughout the bay. Rises on the lake floor, reef-island chains and localized currents induced by prevailing winds were all envisaged as potentially preventative to normal dispersal of tailings materials. Thus, for purposes of regression analyses, site "C" was divided into two units; Group I being beyond the protective reef-island chain, and Group II consisting of stations within the protected area.

Blocks "A" and "B" mean mercury concentrations* were 0.03 and 0.02 µg/g, respectively, whereas block "C" concentrations were approximately one order of magnitude greater (mean = 0.3 µg/g). The block means were significantly different at F 0.95. Within the protected area of block "C", mercury concentrations were found to increase exponentially as the mouth of the major stream draining the tailings disposal site was approached. The regression was significant at $t\alpha = 0.05$ and a near perfect correlation ($r^2 = 0.99$) was obtained for the equation µg/g Hg = 3.34 exp. (3.45 (km)). As the mercury concentration of the station 46 sample was not determined due to laboratory loss of sample, the value may be estimated from the Group II equation. This estimated value of 3.34 µg/g seems improbably high when compared to the mean mercury concentration of the tailings samples (0.90 ± 1.0 µg/g). However, as the Dickson test for outliers fails to reject the estimated value at a 95% level of confidence, the Group II equation would appear valid.

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* Both wet and dry weight mercury data are tabulated as volatilization occurs during the preparatory drying process and frequently results in substantial losses of mercury from the sample. However, the remarks pertain to dry weight data as analytical losses appear to have been minimized.

TABLE 2. SUMMARIZATION AND ANALYSIS OF VARIANCE OF METAL AND CYANIDE CONCENTRATIONS (DRY WEIGHT) IN GODS LAKE SEDIMENTS, 1981.

SAMPLE BLOCK	METAL / STATISTICAL PARAMETER	Hg Wet (µg/g)	Hg (µg/g)	As (µg/g)	Cd (µg/g)	Cu (µg/g)	Pb (µg/g)	Ni (µg/g)	Zn (µg/g)	Fe (%)	Mn (µg/g)	CN (µg/g)	TREATMENT
"A"	$\bar{x}$	L0.02	0.03	4.17	1.5	27.0	18.5	36.7	84.5	2.56	518	L1.0	SUMMARIZATION
	∂	0.0	0.012	1.152	0.516	8.401	5.041	10.354	25.851	0.741	161.725	0.0	
	Hi	0.02	0.06	5.50	2.0	33.0	25.0	43.0	95.0	3.10	725	L1.0	
	Lo	L0.02	L0.02	1.23	L1.0	6.0	L5.0	10.0	18.0	0.65	125	L1.0	
	N	15	15	15	15	15	15	15	15	15	15	3	
"B"	$\bar{x}$	L0.02	L0.02	1.20	1.1	4.9	5.5	8.2	14.8	0.50	73.7	L1.0	
	∂	0.0	0.0	0.29	0.26	1.67	2.066	1.207	3.629	0.12	21.77	0.0	
	Hi	0.02	L0.02	1.73	2.0	10.0	13.0	10.0	20.0	0.70	125	L1.0	
	Lo	L0.02	L0.02	0.70	L1.0	3.0	L5.0	5.0	8.0	0.25	35	L1.0	
	N	15	15	15	15	15	15	15	15	15	15	2	
"C"	$\bar{x}$	0.13	0.30	8.51	1.6	37.9	20.6	23.1	83.4	1.85	518	5.9	
	∂	0.245	0.513	12.564	0.756	51.017	22.308	24.567	92.198	2.228	1370.7	2.967	
	Hi	0.77	1.57	41.3	3.0	138.0	80.0	100.0	280.0	8.80	5300.0	8.1	
	Lo	L0.02	L0.02	1.00	L1.0	5.0	L5.0	8.0	12.0	0.55	69.0	2.5	
	N	9	9	14	14	14	14	14	14	14	14	3	
ANOVA	F	3.14	4.45	3.87	3.96	4.86	5.82	13.37	8.07	9.26	1.60	6.31	ANOVA
	d.f.	2,36	2,36	2,41	2,41	2,41	2,41	2,41	2,41	2,41	2,41	2,5	
	F.95	3.28	3.28	3.23	3.23	3.23	3.23	3.23	3.23	3.23	3.23	5.79	

TABLE 3. REGRESSIONS OF SEDIMENT METAL AND CYANIDE CONCENTRATIONS ($\mu g/g$) ON DISTANCE **(km) FROM MOUTH OF STREAM DRAINING TAILINGS DISPOSAL SITE.

TREATMENT *	Where: $\mu g/g = a\, e^{b(Km)}$	Hg (Wet)	Hg (Dry)	As	Cd	Cu	Pb	Ni	Zn	Fe(%)	Mn	CN
GROUP I :	a	0.17	0.64	12.08	1.34	58.67	26.85	27.56	109.04	1.76	164.04	—
Stations 31,34,	b	-2.13	-3.18	-1.02	0.14	-1.06	-0.62	-0.57	-0.93	-0.41	-0.07	—
35,37,	r^2	0.90	0.83	0.20	0.04	0.22	0.13	0.35	0.23	0.11	0.01	—
41,43,	Ho: $\beta = 0$	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	Accept	—
44,46.	(t_α=0.05)											
GROUP II :	a	1.30	3.36	22.36	2.31	79.56	49.03	70.03	240.70	6.34	1173.58	—
Stations 33,36	b	-3.02	-3.45	-2.07	-0 51	-1.72	-1.53	-1.48	-1.63	-1.66	-1	—
38,40	r^2	0.96	0.99	0.89	0.42	0.88	0.96	0.84	0.97	0.86	0.53	—
42,45,	Ho: $\beta = 0$	Accept	Reject	Reject	Accept	Reject	Reject	Reject	Reject	Reject	Reject	—
46.	(t_α =0.05,											
GROUP III :	a	0.28	0.85	12.37	1.57	56.84	3.51	39.16	136.74	2.68	365.17	7.405
All Stations	b	-2.02	-2.64	-1.36	-0.11	-1.27	-0.00	-0.95	-1.15	-0.85	-0.85	-0.36
Of	r^2	0.70	0.77	0. 38	0.02	0..38	0.35	0.52	0.4	0.34	0.19	0.13
BLOCK "C"	Ho: $\beta = 0$	Accept	Reject	Reject	Accept	Reject	Reject	Reject	Reject	Reject	Accept	Accept
	(t_α=0.05)											

*Stations 32 and 39 are excluded because bottom bonsisted of bare rock and no sediments were obtained.

** DISTANCES FROM STREAM MOUTH ESTIMATED AS FOLLOWS:

GROUP I: STATION	DISTANCE	GROUP II: STATION	DISTANCE
31	- 0.781 km	33	- 1.000 km
34	- 0.260 km	36	- 1.323 km
35	- 1.156 km	38	- 1.427 km
37	- 0.115 km	40	- 0.270 km
41	- 1.250 km	42	- 1.208 km
43	- 0.406 km	45	- 1.490 km
44	- 1.719 km	46	- 0.001 km
46	- 0.001 km		

Continuing with the examination of block "C" data, the regression performed on Group I stations was also well correlated ($r^2 = 0.83$), but the slope was not significantly different from 0 ($t_\alpha = 0.05$) and a relationship between mercury concentrations in sediments and distance from the stream mouth could not be assured for the outer non-protected area of block "C" (Group I stations). Incorporation of all site "C" data (Group III) resulted in a significant regression which exhibited a somewhat lesser degree of correlation ($r^2 = 0.77$). In summation, it appeared that the stream draining the tailings disposal site was a source of mercury contamination to the sediments of the block "C" site. However, dispersal was restricted to the inshore area south-westerly of the stream mouth due largely to a combination of wind induced currents and a semi-protective reef-island barrier (Figure 5).

Block mean arsenic concentrations also exhibited significant differences at F 0 95. Concentrations in the outlet area, block "B", were lowest and averaged 1.2 µg/g. Block "A" concentrations, averaging 4.17 µg/g, indicated the strong influence of a watershed unit likely bearing substantial natural occurrences of arsenopyrites. As with mercury, close examination of block "C" data yielded the most useful information. Within the protected area of Group II stations, arsenic concentrations were also observed to increase exponentially as the mouth of the major drainage stream was approached. The regression was significant at t = 0.05 and a good correlation ($r^2 = 0.89$) was obtained for the equation µg/g As = 22.36 exp. (-2.07) exp. -2.07 (km). As with mercury, a regression of Group I data was not significant whereas incorporation of all site "C" data produced a significant, through somewhat weak correlation. Again, the major drainage stream appeared to

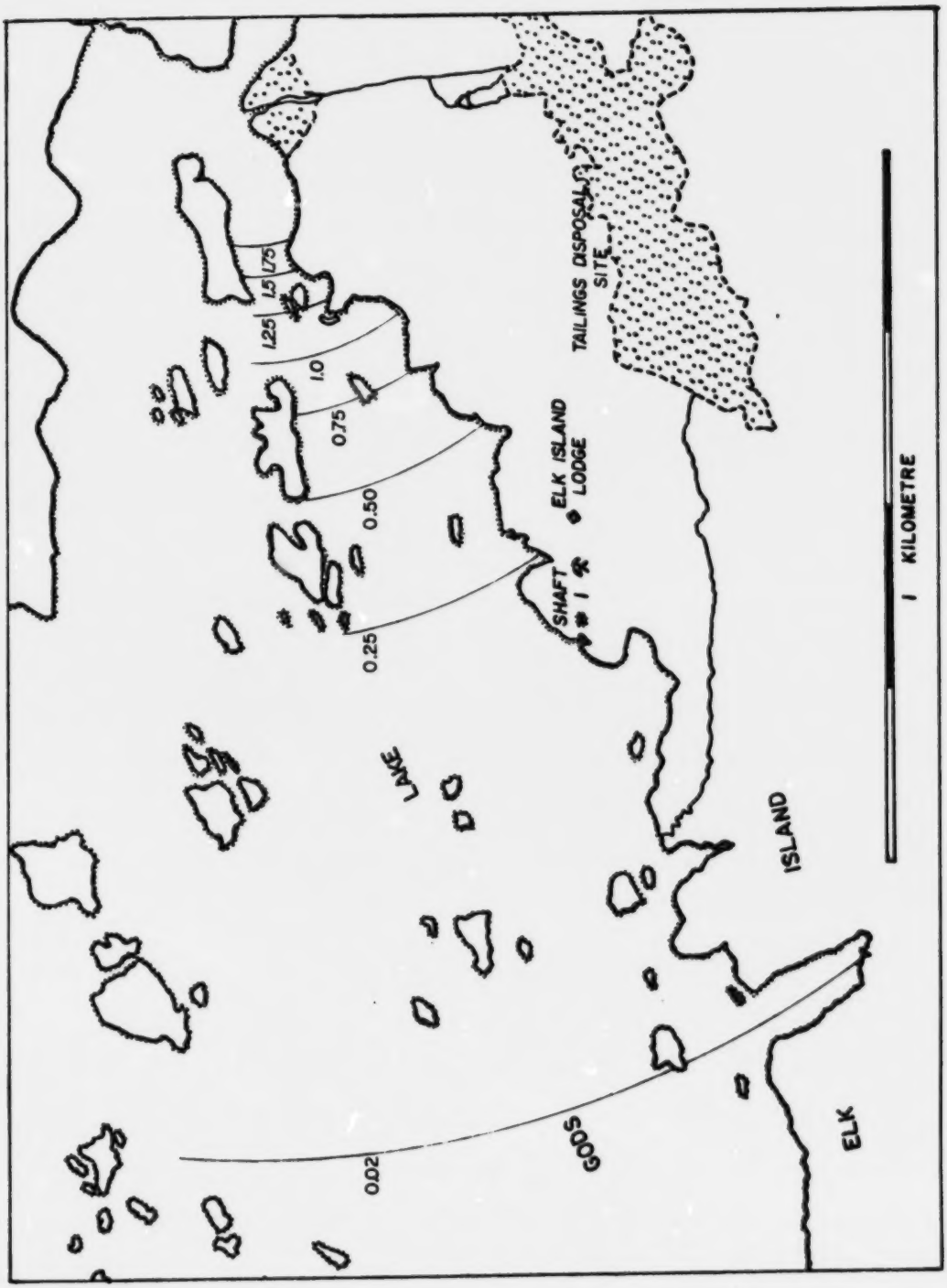

FIGURE 5. Isopleths of Mercury in Sediments, Gods Lake. Block "C" (µg/g).

act as a source of arsenic contamination to site "C" with dispersal restricted to the inshore area southwesterly of the stream mouth (Figure 6).

Cadmium was unique among the sedimented metals included in this study. Although block mean cadmium concentrations differed significantly at F 0.95, application of the previously described statistical procedures to block "C" data failed to yield a significant correlation between sediment cadmium concentrations and proximity to the major drainage stream mouth. Evidently concentrations in the tailings (mean = 2.6 µg/g, Table 8) were not sufficiently elevated to pose a significant source of cadmium contamination to the immediate environs. Block mean concentrations were thought to differ significantly because of the anomalies inherent with statistical analysis of "clumped" small values data. Block mean concentrations of copper, lead and zinc also differed significantly F 0.95. However, mean concentrations for each of these metals in block "A" did not appear dissimilar to those of block "C", while those of "B" were considerably lower. Clearly the utilization of block "A" as a control for these metals was not appropriate. As with the metals previously discussed, it was the examination of the dynamics occurring within block "C" that proved most informative. Again, good correlations were obtained for regressions describing the exponential increase in concentrations of copper (µg/g Cu - 79.56 exp. (-1.72 (km)); r^2 = 0.88), lead (µg/g Pb = 49.03 exp. (-1.53 (km)); r = 0.96) and zinc (µg/g Zn = 240.70 exp. (-1.63 (km)); r^2 = 0.97) within the "protected" area as the major drainage stream mouth was approached (Figures 7, 8 and 9, respectively). Sources of these metals in the tailings appeared to be the varying amounts of chalcopyrite ($CuFeS_2$),

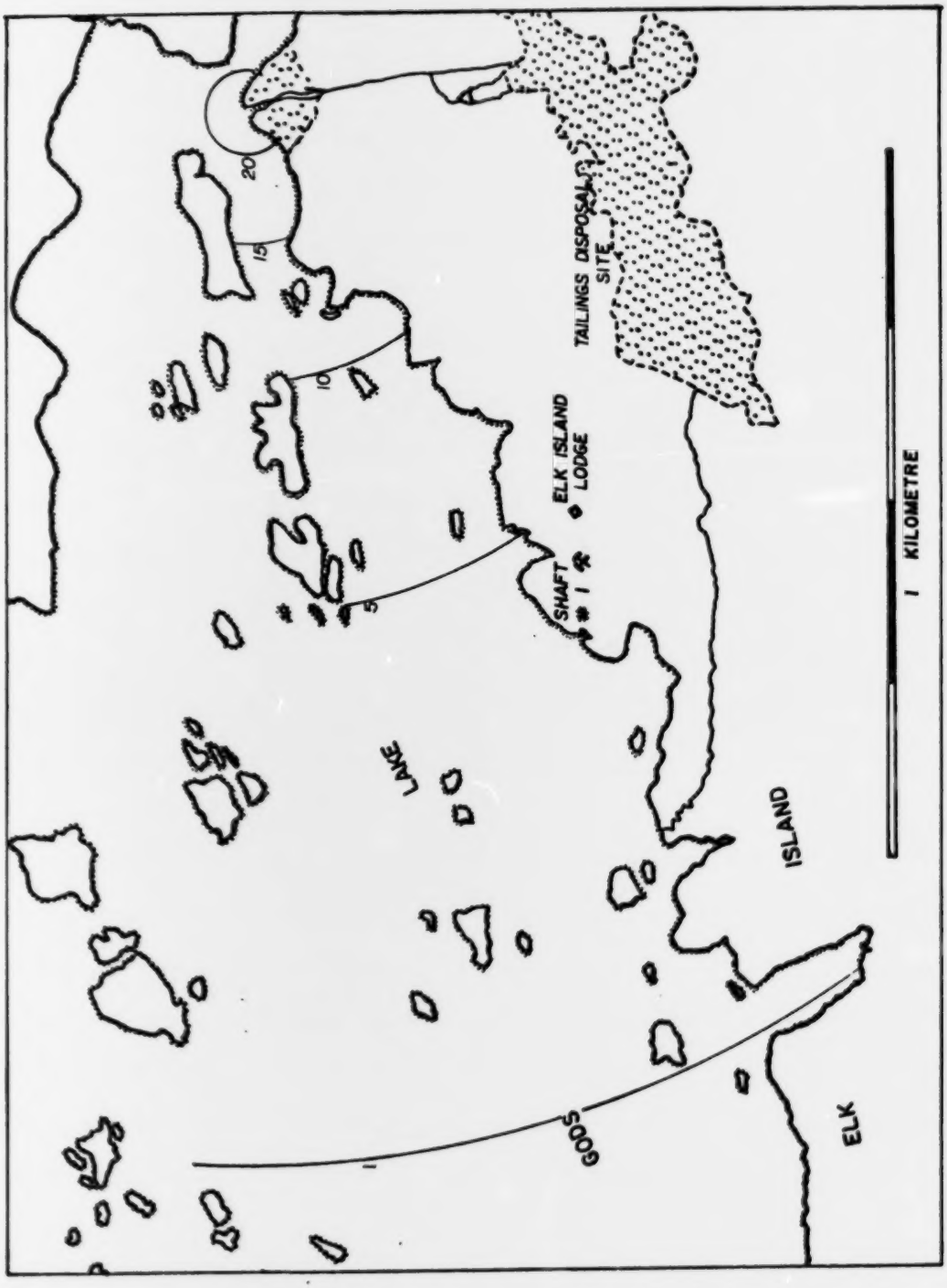

FIGURE 6. Isopleths of Arsenic in Sediments, Gods Lake. Block "C" (µg/g)

galena (PbS) and sphalerite (ZnS) described as occurring within and being processed along with the general orebody.

The status of nickel closely parallels that of copper, lead and zinc (Figure 10). The Group II site "C" correlation ($r^2 = 0.84$) was significant at $t = 0.05$ for the regression $\mu g/g$ Ni - 70.03 exp. (-1.48(km)). The source of nickel to the tailings at first appears mysterious as specific nickel bearing mineral was not described as occurring within the orebody. However, nickel is commonly bound with iron in most sulfides (Fairbridge, 1972) and therefore the pyritic (FeS) nature of the orebody itself may have contributed nickel to the tailings.

Block mean concentrations of iron were significantly different at F 0.95 whereas those of manganese were not. Regressions of Group II site "C" iron data indicated a significant correlation ($t_\alpha = 0.05$) between concentration and proximity to the major drainage stream mouth ($\mu g/g$ Fe = 6.34 exp. (-1.63(km)); $r^2 = 0.86$). Though manganese also appeared significant ($\mu g/g$ Mn = 1173.58 exp. (-1.84 (Km)); $r^2 = 0.53$), acceptance of an hypothetical relationship would appear to constitute a beta type statistical error as the regression was greatly influence by the presence of apparent manganese nodules in the station 40 sample (D. Williamson, pers. comm). As neither metal is presently known to be particularly toxic to aquatic life forms and, as both readily precipitate out of the water column, neither should be considered a serious contaminant to Gods Lake.

Like most of the metals, block mean cyanide concentrations also evinced significant differences at F 0.95. None of the samples from block "A" and "B" yielded detectable concentrations of cyanide whereas the three

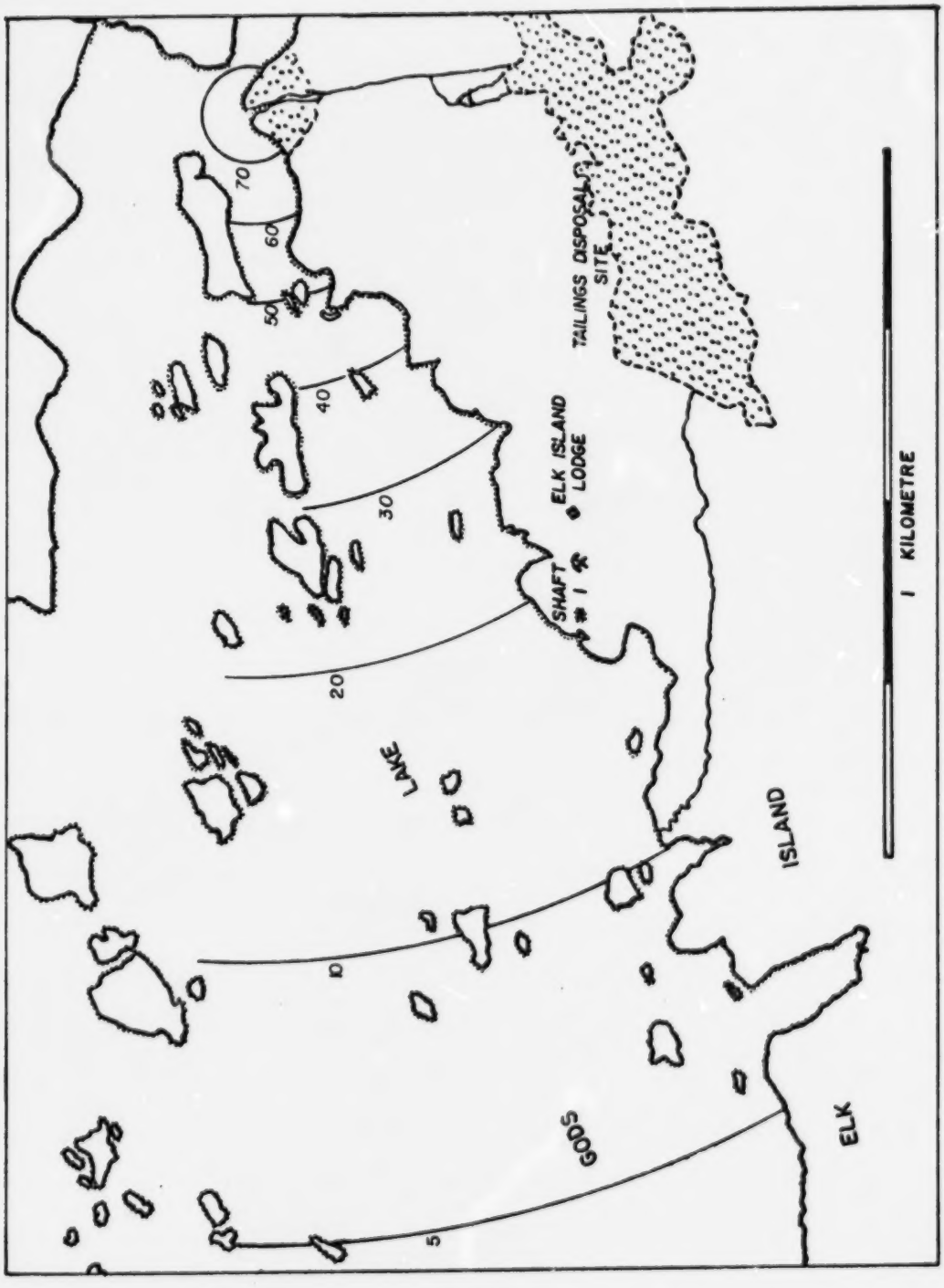

FIGURE 7. Isopleths of Copper in Sediments, Gods Lake. Block "C" (µg/g)

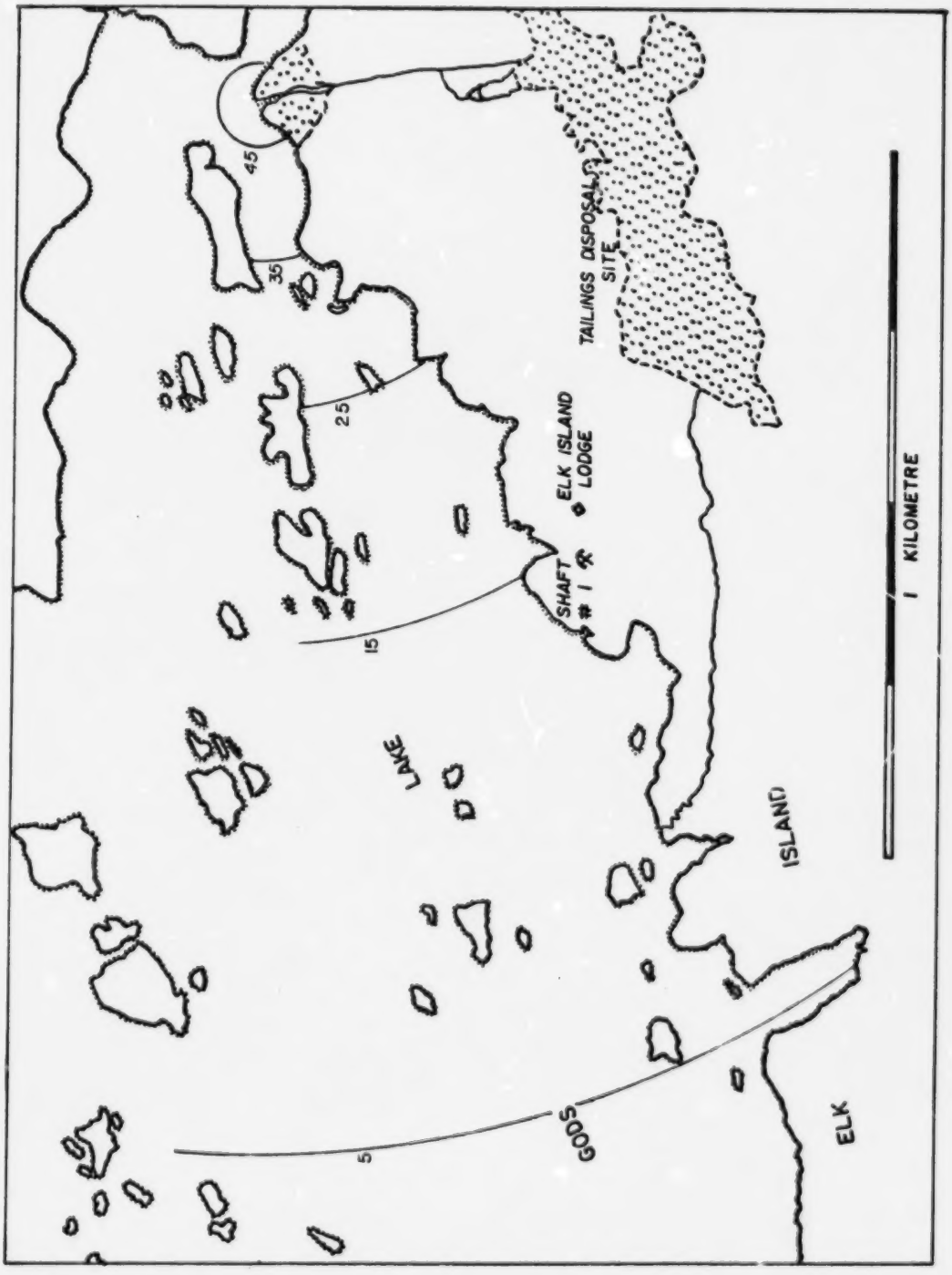

FIGURE 8. Isopleths of Lead in Sediments, Gods Lake. Block "C" (µg/g)

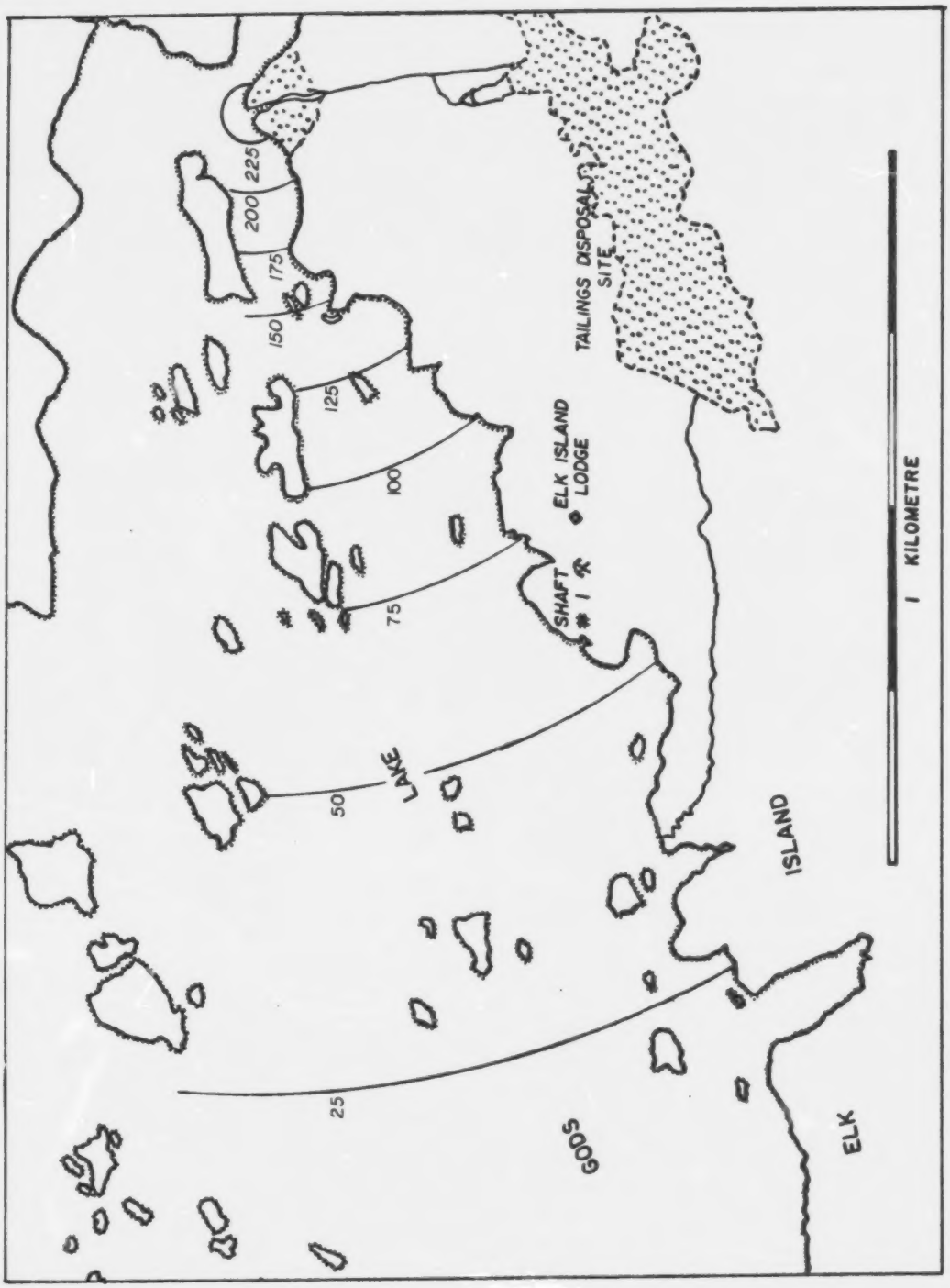

FIGURE 9. Isopleths of Zinc in Sediments, Gods Lake. Block "C" (µg/g)

FIGURE 10. Isopleths of Nickel in Sediments, Gods Lake. Block "C" (µg/g)

samples from block "C" averaged 5.9 μg/g cyanide. Site "C" data was not adequate to describe a significant correlation between concentrations and proximity to the major drainage stream mouth. However, the cyanide occurring in block "C" may safely be assumed to have originated from the Gods Lake Mine milling process.

Uptake of Metals by Fish

Gillnetting results are described in Appendix 3. General meristics and muscle tissue metal concentrations are detailed in Appendix 4. These data have been summarized in Table 4. Regressions of the consistently detectable metals (mercury, arsenic, copper and zinc) on weight are presented in Table 5 along with regression derived estimations of metal concentrations at species dependent, equidistant weights of a range common to each of the sampling blocks. Results of analysis of variance of both observed and estimated concentrations are described in Table 6.

Levels of mercury in excess of 0.50 μg/g were found in 6 of the 230 fish sampled. One pike from each of blocks A, B and C (0.51, 1.13 and 0.52 μg/g, respectively) as well as three walleye from block B (0.65, 0.50 and 0.70 μg/g) were in this category. Mean concentrations per species per block were, however, well below the 0.50, federal limit for commercial sale of fish in Canada.

Both observed and estimated block mean mercury concentrations in the muscle tissue of pike and longnose suckers were not significantly different at F 0.95. Significant different occurred between estimated block

TABLE 4:(a) SUMMARIZATION OF GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS (µg/g); NORTHERN PIKE

Sampling Block	Statistic	N	Sex (M/F)	Length (cm)	Weight (g)	Age (yrs)	Muscle Tissue Metal Concentration (µg/g)						
							Hg	As	Pb	Cu	Zn	Ni	Cd
A	$\bar{x}$	20	0.67	72.2	2742	9.8	0.30	0.02	0.53	0.15	6.53	LO.5	LO.1
	∂	-	-	9.07	1260	2.3	0.102	0.004	0.092	0.100	1.18	0.0	0.0
	Hi	-	-	92.0	5830	15	0.51	0.03	0.80	0.50	9.0	LO.5	LO.1
	Lo	-	-	55.5	1340	7	0.13	LO.02	LO.50	LO.10	4.8	LO.5	LO.1
	MODE*	-	F	-	-	-	-	-	LO.50	-	-	LO.5	LO.1
B	$\bar{x}$	20	0.43	64.7	2041	8.4	0.26	0.05	LO.50	0.36	4.36	0.57	LO.1
	∂	-	-	5.45	556.5	2.04	0.22	0.027	0.0	0.25	0.933	0.225	0.0
	Hi	-	-	74.5	3020	13	1.13	0.14	0.50	0.90	5.8	1.4	LO.1
	Lo	-	-	52.5	1160	5	0.08	0.03	LO.50	0.10	3.0	LO.5	LO.1
	MODE*	-	F	-	-	-	-	-	LO.50	-	-	LO.5	LO.1
C	$\bar{x}$	20	0.25	60.8	1626	7.2	0.29	0.04	0.52	0.48	4.55	LO.50	LO.1
	∂	-	-	6.48	569	1.79	0.093	0.018	0.67	0.214	1.33	0.0	0.0
	Hi	-	-	75.9	3240	11	0.52	0.09	0.80	0.90	8.4	0.50	LO.1
	Lo	-	-	50.1	900	5	0.11	LO.02	LO.50	LO.10	3.2	LO.50	LO.1
	MODE*	-	F	-	-	-	-	-	LO.50	-	-	LO.50	LO.1

* Expressed only where mode $\geq$ N/2.

TABLE 4(b): SUMMARIZATION OF GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS (µg/g); LAKE WHITEFISH.

Sampling Block	Statistic	N	Sex (M/F)	Length (cm)	Weight (g)	Age (yrs)	Muscle Tissue Metal Concentration (µg/g)						
							Hg	As	Pb	Cu	Zn	Ni	Cd
A	$\bar{x}$	7	1.33	44.0	1240	16.4	0.06	0.04	LO.50	0.29	5.71	LO.5	LO.1
	∂	-	-	6.85	316.9	4.76	0.026	0.0195	0.0	0.267	1.012	0.0	0.0
	Hi	-	-	50.4	1580	25	0.10	0.08	0.50	0.80	7.40	LO.5	LO.1
	Lo	-	-	33.7	670	11	0.03	0.02	LO.50	0.10	4.80	LO.5	LO.1
	MODE*	-	M	-	-	-	-	-	LO.50	-	-	LO.5	LO.1
B	$\bar{x}$	20	1.38	45.2	1325	14.1	0.10	0.06	LO.50	0.17	4.25	LO.5	LO.1
	∂	-	-	3.65	320.8	3.58	0.053	0.034	0.0	0.122	0.786	0.0	0.0
	Hi	-	-	55.0	2220	21	0.20	0.16	0.50	0.50	6.30	0.5	LO.1
	Lo	-	-	38.8	850	9	0.03	LO.02	LO.50	LO.10	3.30	LO.5	LO.1
	MODE*	-	M	-	-	-	-	-	LO.50	0.10	-	LO.5	LO.1
C	$\bar{x}$	20	1.0	41.8	1002	12.8	0.11	0.08	LO.50	0.15	3.86	LO.5	LO.1
	∂	-	-	3.61	24.77	3.44	0.061	0.040	0.0	0.12	0.70	0.0	0.0
	Hi	-	-	48.3	1400	23	0.26	0.19	LO.50	0.50	5.40	0.5	LO.1
	Lo	-	-	36.3	640	9	0.03	0.03	LO.50	LO.10	3.00	LO.5	LO.1
	MODE*	-	M,F	-	-	-	-	-	LO.50	0.10	-	LO.5	LO.1

*Expressed only where mode $\geq$ N/2.

TABLE 4(c): SUMMARIZATION OF GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS (µg/g) WALLEYE.

Sampling Block	Statistic	N	Sex (M/F)	Length (cm)	Weight (g)	Age (Yrs)	Muscle Tissue Metal Concentration (µg/g)						
							Hg	As	Pb	Cu	Zn	Ni	Cd
A	$\bar{x}$	20	0.67	44.3	1010	12.4	0.18	0.03	0.53	0.22	5.85	<0.50	<0.1
	δ	-	-	4.76	32.95	3.51	0.071	0.009	0.092	0.211	0.873	0.0	0.0
	Hi	-	-	53.0	1700	18	0.32	0.05	0.80	0.80	7.40	<0.50	<0.1
	Lo	-	-	37.0	520	7	0.10	0.02	<0.50	<0.10	4.40	<0.50	<0.1
	Mode*	-	F	-	-	11	-	0.02	<0.50	-	-	<0.50	<0.1
B	$\bar{x}$	8	0.33	51.5	1448	19.6	0.48	0.06	0.56	0.18	4.69	0.63	<0.1
	δ	-	-	2.71	253.5	4.41	0.133	0.016	0.177	0.139	1.31	0.231	0.0
	Hi	-	-	54.7	1930	29	0.70	0.09	1.00	0.5	7.30	1.00	<0.1
	Lo	-	-	47.4	1120	15	0.33	0.04	<0.50	<0.10	3.20	<0.50	<0.1
	Mode*	-	F	-	-	-	-	-	<0.50	0.10	-	<0.50	<0.1
C	$\bar{x}$	15	0.15	41.0	820	11.2	0.20	0.05	<0.50	0.11	3.72	0.53	<0.1
	δ	-	-	2.58	173.2	3.21	0.487	0.014	0.0	0.035	0.054	0.129	0.0
	Hi	-	-	45.8	1180	22	0.27	0.03	<0.50	0.20	4.50	1.00	<0.1
	Lo	-	-	36.1	520	8	0.11	0.09	<0.50	<0.10	3.00	<0.50	<0.1
	Mode*	-	F	-	-	11	-	-	<0.50	<0.10	-	<0.50	<0.1

*Expressed Only Where Mode $\geq$ N/2.

TABLE 4(d): SUMMARIZATION OF GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS ($\mu g/g$), COMMON SUCKER.

Sampling Block	Statistic	N	Sex (M/F)	Length (cm)	Weight (g)	Age (Yrs)	Muscle Tissue Metal Concentration ($\mu g/g$)						
							Hg	As	Pb	Cu	Zn	Ni	Cd
A	-	20	0.25	42.9	1248	11.3	0.06	0.03	<0.50	0.44	3.72	0.57	<0.1
	δ	-	-	3.64	286.4	2.39	0.019	0.009	0.0	0.179	1.202	0.291	0.0
	Hi	-	-	48.3	1800	16	0.10	0.06	<0.50	0.80	7.20	1.80	<0.1
	Lo	-	-	33.6	610	5	0.03	<0.02	<0.50	0.10	2.60	<0.50	<0.1
	Mode*	-	F	-	-	-	-	-	<0.50	-	-	<0.50	<0.1
B	-	No Samples Obtained											
	δ												
	Hi												
	Lo												
	Mode*												
C	-	20	1.0	41.6	1131	10.5	0.17	0.05	<0.05	0.17	4.98	<0.50	<0.1
	δ	-	-	3.80	286.1	3.85	0.105	0.019	0.0	0.098	0.95	0.0	0.0
	Hi	-	-	47.2	1590	17	0.35	0.09	<0.50	1.00	6.60	<0.50	<0.1
	Lo	-	-	35.8	660	5	0.04	0.02	<0.50	0.10	3.30	<0.50	<0.1
	Mode*	-	M,F	-	-	-	-	-	<0.50	0.20	-	<0.50	<0.1

* Expressed Only Where Mode $\geq$ N/2

TABLE 4(e): SUMMARIZATION OF GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS ($\mu g/g$); LONGNOSE SUCKER.

Sampling Block	Statistic	N	Sex (M/F)	Length (cm)	Weight (g)	Age (Yrs)	Muscle Tissue Metal Concentration ($\mu g/g$)						
							Hg	As	Pb	Cu	Zn	Ni	Cd
A	$\bar{x}$												
	δ												
	Hi												
	Lo						No Samples Obtained						
	Mode*												
B	$\bar{x}$	20	0.58	47.2	1581	14.5	0.09	0.07	<0.50	0.28	4.32	0.55	<0.1
	δ	-	-	3.62	326.7	2.31	0.047	0.048	0.0	0.231	1.183	0.224	0.0
	Hi	-	-	56.4	2440	20	0.21	0.19	<0.50	0.90	6.60	1.50	<0.1
	Lo	-	-	41.3	1100	11	0.03	0.02	<0.50	0.10	2.90	<0.50	<0.1
	Mode*	-	F	-	-	-	-	-	<0.50	-	-	<0.50	<0.1
C	$\bar{x}$	20	1.33	45.6	1428	13.4	0.10	0.10	0.53	0.29	4.96	<0.50	<0.1
	δ	-	-	4.12	402.8	2.46	0.068	0.054	0.112	0.216	1.255	0.0	0.0
	Hi	-	-	53.2	2360	19	0.26	0.23	1.00	1.00	8.30	0.50	<0.1
	Lo	-	-	40.6	910	10	0.05	<0.02	<0.50	0.10	3.60	<0.50	<0.1
	Mode*	-	M	-	-	-	-	-	<0.50	0.20	-	<0.50	<0.1

* Expressed Only Where Mode $\geq$ N/2.

TABLE 5(a): REGRESSIONS OF $\mu g/g$ Hg ON WEIGHT AND ESTIMATED MERCURY CONCENTRATIONS

Species	Sampling Block	Where $\mu g/g$ = b(Wt.) + a			Estimated $\mu g/g$ at :				Ho:b = 0 td = 0.0
		a	b	r^2					
					1000g	2000g	3000g	4000g	
Northern Pike	A	0.16	5.17×10^{-5}	0.41	0.21	0.26	0.31	0.37	Reject
	B	-0.08	1.70×10^{-4}	0.18	0.08	0.25	0.42	0.59	Accept
	C	0.07	1.26×10^{-4}	0.57	0.19	0.32	0.45	0.57	Reject
					750g	1000g	1250g	1500g	
Lake Whitefish	A	-1.37×10^{-3}	5.18×10^{-5}	0.41	0.04	0.05	0.06	0.08	Accept
	B	0.04	3.23×10^{-5}	0.04	0.07	0.08	0.08	0.09	Accept
	C	-0.01	1.21×10^{-4}	0.24	0.08	0.11	0.14	0.17	Reject
					750g	1000g	1250g	1500g	
Walleye	A	0.08	1.00×10^{-4}	0.22	0.16	0.18	0.21	0.23	Reject
	B	0.53	-3.61×10^{-5}	0.01	0.50	0.49	0.49	0.48	Accept
	C	0.10	1.22×10^{-4}	0.19	0.19	0.22	0.25	0.28	Accept
					900g	1100g	1300g	1500g	
Common Sucker	A	0.01	3.55×10^{-5}	0.27	0.04	0.05	0.06	0.06	Reject
	C	-0.01	1.57×10^{-4}	0.18	0.14	0.17	0.20	0.23	Accept
					1100g	1300g	1500g	1700g	
Longnose Sucker	B	-0.02	7.10×10^{-5}	0.24	0.06	0.07	0.09	0.10	Reject
	C	-0.10	1.38×10^{-4}	0.67	0.05	0.08	0.11	0.14	Reject

TABLE 5(b): REGRESSIONS OF µg/g As ON WEIGHT AND ESTIMATED ARSENIC CONCENTRATIONS

Species	Sampling Block	Where µg/g = b(Wt.) + a			Estimated µg/g at:				Ho:b = 0 ($t_{.1} = 0.05$)
		a	b	r^2					
					1000g	2000g	3000g	4000g	
Northern Pike	A	0.02	8.35×10^{-7}	0.06	0.02	0.02	0.02	0.02	Accept
	B	-0.01	2.85×10^{-5}	0.34	0.02	0.05	0.08	0.11	Reject
	C	-1.69×10^{-4}	2.44×10^{-5}	0.60	0.02	0.04	0.07	0.09	Reject
					750g	1000g	1250g	1500g	
Lake Whitefish	A	0.02	1.81×10^{-5}	0.09	0.03	0.03	0.04	0.04	Accept
	B	0.13	-5.29×10^{-5}	0.24	0.09	0.08	0.06	0.05	Reject
	C	0.10	-2.24×10^{-5}	0.02	0.08	0.08	0.07	0.07	Accept
					750g	1000g	1250g	1500g	
Walleye	A	0.02	6.67×10^{-6}	0.06	0.03	0.03	0.03	0.03	Accept
	B	0.04	1.44×10^{-5}	0.05	0.05	0.05	0.06	0.06	Accept
	C	0.05	8.57×10^{-6}	0.01	0.05	0.05	0.06	0.06	Accept
					900g	1100g	1300g	1500g	
Common Sucker	A	0.02	8.47×10^{-7}	0.01	0.03	0.03	0.03	0.03	Accept
	C	0.06	-5.24×10^{-6}	0.01	0.05	0.05	0.05	0.05	Accept
					1100g	1300g	1500g	1700g	
	B	0.15	-4.73×10^{-5}	0.10	0.09	0.08	0.07	0.07	Accept
	C	0.20	-7.48×10^{-5}	0.32	0.12	0.11	0.09	0.08	Reject

TABLE 5(c): REGRESSIONS OF µg/g Cu ON WEIGHT AND ESTIMATED COPPER CONCENTRATIONS

Species	Sampling Block	Where µg/g = b(Wt.) + a			Estimated µg/g at:				Ho:b = 0 (t_{α} = 0.05
		a	b	r^2					
					1000g	2000g	3000g	4000g	
Northern Pike	A	0.20	-2.11×10^{-5}	0.07	0.18	0.16	0.14	0.12	Accept
	B	0.54	-8.98×10^{-5}	0.04	0.45	0.36	0.27	0.18	Accept
	C	0.39	5.63×10^{-5}	0.02	0.44	0.50	0.56	0.61	Accept
					750g	1000g	1250g	1500g	
Lake Whitefish	A	0.58	-2.36×10^{-4}	0.08	0.40	0.34	0.28	0.22	Accept
	B	0.22	-3.89×10^{-5}	0.01	0.19	0.18	0.17	0.16	Accept
	C	0.40	-2.46×10^{-4}	0.24	0.21	0.15	0.09	0.03	Reject
					750g	1000g	1250g	1500g	
Walleye	A	0.17	4.76×10^{-5}	0.01	0.20	0.21	0.23	0.24	Accept
	B	-0.40	3.97×10^{-4}	0.52	<0.01	<0.01	0.10	0.20	Reject
	C	0.06	6.90×10^{-5}	0.12	0.11	0.13	0.14	0.16	Accept
					900g	1100g	1300g	1500g	
Common Sucker	A	0.49	-4.47×10^{-5}	0.01	0.45	0.44	0.43	0.42	Accept
	C	0.13	3.90×10^{-5}	0.01	0.16	0.17	0.18	0.18	Accept
					1100g	1300g	1500g	1700g	
Longnose Sucker	B	0.30	-1.22×10^{-5}	<0.01	0.29	0.28	0.28	0.28	Accept
	C	0.14	9.40×10^{-5}	0.05	0.24	0.26	0.28	0.30	Accept

TABLE 5(d): REGRESSIONS OF µg/g Zn ON WEIGHT AND ESTIMATED ZINC CONCENTRATIONS

Species	Sampling Block	Where µg/g = b(Wt.) + a			Estimated µg/g at:				Ho:b = 0 (t_f = 0.05)
		a	b	r^2	1000g	2000g	3000g	4000g	
Northern Pike	A	5.55	3.55×10^{-4}	0.14	5.91	6.26	6.62	6.97	Accept
	B	4.83	-2.27×10^{-4}	0.02	4.60	4.37	4.14	3.91	Accept
	C	4.82	-1.68×10^{-4}	0.01	4.66	4.49	4.32	4.15	Accept
					750g	1000g	1250g	1500g	
Lake Whitefish	A	5.13	4.75×10^{-4}	0.02	5.48	5.60	5.72	5.84	Accept
	B	4.74	-3.75×10^{-4}	0.02	4.46	4.37	4.27	4.18	Accept
	C	4.36	-5.03×10^{-4}	0.03	3.98	3.86	3.73	3.60	Accept
					750g	1000g	1250g	1500g	
Walleye	A	2.60	1.36×10^{-3}	0.19	3.62	3.97	4.31	4.65	Accept
	B	5.55	2.93×10^{-4}	0.01	5.77	5.85	5.92	5.99	Accept
	C	-0.60	3.65×10^{-3}	0.50	2.14	3.05	3.97	4.88	Reject
					900g	1300g	1500g	1700g	
Common Sucker	A	3.15	4.60×10^{-4}	0.01	3.56	3.65	3.74	3.84	Accept
	C	5.00	-2.41×10^{-5}	0.01	4.98	4.98	4.97	4.97	Accept
					1100g	1300g	1500g	1700g	
Longnose Sucker	B	4.00	1.98×10^{-4}	0.01	4.22	4.26	4.30	4.34	Accept
	C	4.23	5.14×10^{-4}	0.03	4.79	4.89	4.99	5.10	Accept

TABLE 6: ANALYSIS OF VARIANCE TO DETERMINE SIGNIFICANT DIFFERENCES BETWEEN BLOCK MEAN METAL CONCENTRATIONS IN FISH MUSCLE TISSUE

Metal	Species	Observed Concentrations			Estimated Concentrations		
		F	d.f.	F.95	F	d.f.	F.95
Hg	Northern Pike	0.35	2,57	3.17	0.34	2,9	4.26
	Lake Whitefish	1.78	2,44	3.21	7.63	2,9	4.26
	Walleye	43.12	2,40	3.23	121.30	2,9	4.26
	Common Sucker	23.52	1,38	4.10	44.12	1,6	5.99
	Longnose Sucker	0.11	1,38	4.10	0.49	1,6	5.99
As	Northern Pike	12.26	2,57	3.17	2.72	2,9	4.26
	Lake Whitefish	3.12	2,44	3.21	14.25	2,9	4.26
	Walleye	26.40	2,40	3.23	37.50	2,9	4.26
	Common Sucker	33.50	1,38	4.10	∞	1,6	5.99
	Longnose Sucker	2.70	1,38	4.10	4.76	1,6	5.99
Cu	Northern Pike	14.06	2,57	3.17	21.94	2,9	4.26
	Lake Whitefish	2.16	2,44	3.21	9.43	2,9	4.26
	Walleye	1.78	2,40	3.23	6.66	2,9	4.26
	Common Sucker	13.03	1,38	4.10	1203.86	1,6	5.99
	Longnose Sucker	0.02	1,38	4.10	0.90	1,6	5.99
Zn	Northern Pike	21.34	2,57	3.17	51.78	2,9	4.26
	Lake Whitefish	14.52	2,44	3.21	169.49	2,9	4.26
	Walleye	25.68	2,40	3.23	11.35	2,9	4.26
	Common Sucker	13.42	1,38	4.10	451.51	1,6	5.99
	Longnose Sucker	2.80	1,38	4.10	86.24	1,6	5.99

values for whitefish, but not between the observed concentrations. Both observed and estimated values differed significantly for walleye and common suckers. Significant differences in estimated values were thought to reflect the absence of significant µg/g - weight correlations for whitefish, walleye and common suckers. The regression derived estimations therefore differed artificially due to the narrow, non-normal variances. The source of difference in observed walleye values appeared to be the narrow range of comparatively much older and larger fish composing the sample from block "B". This insignificant overlap in size ranges, hence corresponding mercury concentrations, precluded similar block means. A significant difference was not observed between walleye of the control area ("A") and the impacted site ("C"). The significant difference in block means for common suckers at first, appeared to be real and may have resulted from ingestion of block "C" sediments containing high mercury concentrations during normal feeding activities. However, the absence of significant differences in block mean mercury concentrations for longnose suckers, a species with similar feeding habits, suggested that this assumption was false. Thus, apart from common suckers, the data did not indicate that mercury originating from the tailings disposal area had resulted in increased muscle tissue mercury levels in fish frequenting the sampling block "C" area.

The status of arsenic was somewhat more complicated than that of mercury. Significant differences between observed block mean arsenic concentrations were more abundant than non significant differences (e.g., pike, walleye and common sucker as compared to whitefish and longnose sucker)

and frequently contradicted the analysis of variance of estimated values (e.g., pike and whitefish). However, in general, observed concentrations in block "B" and "C" fish were similar and were significantly greater than those of block "A" fish. This situation was particularly well exemplified by the two sucker species sampled; both observed and estimated mean arsenic concentrations in common suckers of block "A" and "C" (observed: 0.03 and 0.05 µg/g; estimated: 0.03 and 0.05 µg/g; respectively) differed significantly whereas that of longnose suckers from block "B" and "C" (observed: 0.07 and 0.10 µg/g; estimated: 0.08 and 0.10 µg/g; respectively) did not. Although arsenic originating from the major stream draining the tailings disposal site resulted in contamination of inshore sediments of the "C" site and appeared to coincide with elevated concentrations in the muscle tissue of fish from block "B" and "C", the dynamics of arsenic bioaccumulation are not yet well understood and a direct cause-effect relationship could not be ascribed with certainty in this study. However, the consistency of basin differences suggested that arsenic emanating from the tailings disposal site may have at least a contributory factor respecting the elevated levels in the muscle tissue of fish from the "B" and "C" sampling area.

Like arsenic, interpretation of the copper data was also rather complex. Only longnose suckers collected from areas "B" and "C" evinced no significant differences in either observed or estimated mean copper concentrations. Common sucker and pike mean concentrations differed significantly for both observed and estimated values. Neither walleye nor whitefish observed mean

concentrations were different at F 0.95 although estimated values differed significantly. A consistent pattern also failed to emerge when block mean concentrations were assessed subjectively. Northern pike copper levels were comparatively greatest in block "C" fish (0.48 µg/g as to 0.15 and 0.36 µg/g for "A" and "B", respectively), and lowest for whitefish (0.15 µg/g as to 0.29 µg/g and 0.17 µg/g for "A" and "B", respectively), and walleye (0.11 µg/g as to 0.22 and 0.18 µg/g for "A" and "B", respectively). Therefore, if copper emanating from the tailings disposal site was impacting upon the fish of Gods Lake, the effects were well masked by background "noise" and were not detectable.

The situation of zinc appeared more straightforward than any of the previously discussed metals. Only longnose sucker observed mean concentrations evinced no significant differences whereas that of all other species, including estimated values, differed significantly at F 0.95. Excepting common suckers, all site "C" zinc concentrations were comparatively lower than either "A" or "B" levels. Clearly the zinc emanating from the major stream draining the tailings disposal site was not being bioaccumulated by Gods Lake fish in any discernable manner.

Less than 15% of the fish sampled possessed detectable muscle tissue concentrations of lead and nickel (25 and 22 fish, respectively) whereas none of the samples yielded detectable levels of cadmium. Fish containing detectable levels of these metals appeared to be evenly distributed among the three sampling areas. Thus, lead, nickel and cadmium emanating from the major tailings drainage stream did not appear to have bioaccumulated in the fish of Gods Lake. Alternatively, if bioaccumulation was occurring,

the process was developing at concentrations below the detection limits of current instrumentation.

Uptake of Metals by Aquatic Invertebrates

Interpretation of benthic concentration of metals (Table 7) was necessarily very subjective due to the paucity and diversity of organisms collected. Concentrations of mercury, arsenic, cadmium, lead and zinc were greater in the sample collected from area "C". Copper and nickel concentrations were greater in the organisms composing the sample from the "A" site. Because shoreline substrate materials near the mouth of the major stream draining the tailings disposal area (station 46) offered little habitat suitable for colonization by macrobenthic organisms, the site "C" sample was collected from the shoreline approximately 1.84 kilometres (over water distance) southwesterly of station 46. Thus the full impact of metal contaminated sediments could not have been evident in the sample. It was therefore reasonable to conclude that, of the metals emanating from the major drainage stream, at least mercury, arsenic, cadmium, lead and zinc were accumulating at levels beyond background in the bodies of macroinvertebrates colonizing reaches of site "C" which lie within the previously described effluent path.

The Tailings Disposal Site

The tailings disposal site lies immediately east of Elk Island Lodge (Figure 11)and is currently maintained as an aircraft landing strip for the lodge. The tailings "pile" measured approximately 1.0 x 0.25 kilometres (maximum). Drainage from the bulk of the tailings was conducted directly to Gods Lake via the major stream depicted in Figure 11. Extreme ends of the site were drained by very minor streams.

TABLE 7. METAL CONCENTRATIONS OF GODS LAKE BENTHOS

Site / Metal (µg/g)	"A"	"B"	"C"
Hg (Wet)	0.02	0.02	0.03
As	0.29	0.17	0.71
Cd	0.30	*	1.0
Cu	29.7	*	14.5
Pb	<0.50	*	10.0
Ni	1.8	*	0.5
Zn	19.8	*	32.8
Organisms Collected	1 Crayfish Various snails	Various Snails Leeches	Various snails Leeches

* Not analyzed due to insufficient sample.

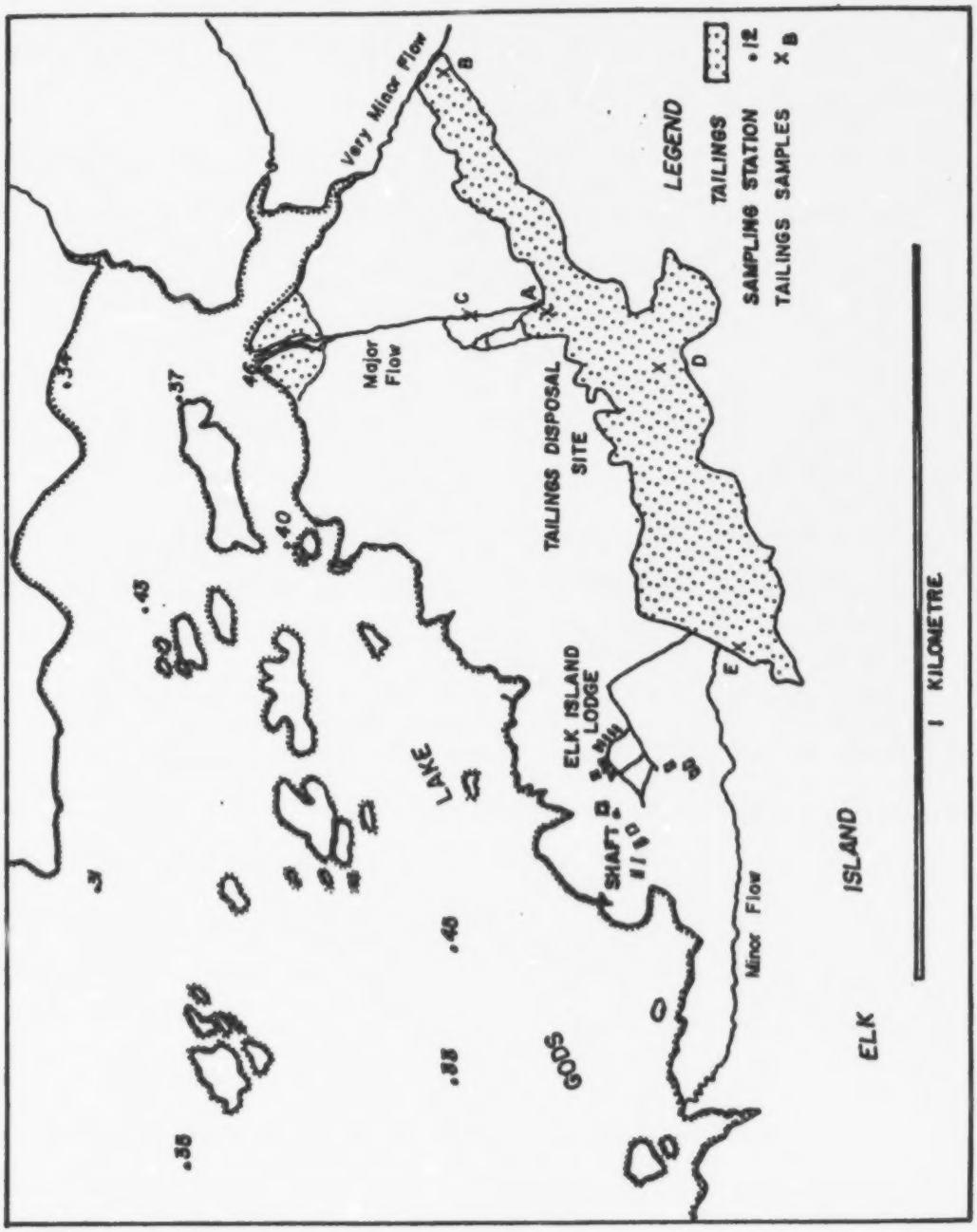

FIGURE H. TAILINGS DISPOSAL SITE

Surficial samples A, B, C and E, when compared to the deeper sample D, indicated that considerable leaching of metals had occurred at the surface of the tailings pile (Table 8). Though much of these metals may have been eluted downwards to deeper strata of the pile, as previously suggested, considerable amounts have also been transported to Gods Lake via the major drainage stream. This was indicated by both comparable metal concentrations at station 46 and the development of an obvious delta of tailings-like materials at the stream mouth. The tailings disposal site was thus the source of metal contamination confirmed in the block "C" area.

TABLE 8: METAL CONCENTRATIONS IN SAMPLES FROM THE TAILINGS DISPOSAL AREA

* Station	Metal Depth	Hg µg/g (wet)	Hg µg/g (dry)	As µg/g	Cd µg/g	Cu µg/g	Pu µg/g	Ni µg/g	Zn µg/g	Fe %	Mn µg/g	CN µg/g
A	0-5 cm	0.05	0.06	8.33	2.0	38.0	25.0	35.0	90.0	2.8	450.0	1.0
B	0-5 cm	0.21	0.26	35.0	2.0	128.0	40.0	50.0	130.0	2.8	275.0	1.0
C	0-5 cm	0.78	0.96	33.2	3.0	160.0	40.0	120.0	260.0	3.2	149.0	
D	20-30 cm	1.57	2.58	59.3	2.0	190.0	105.0	92.0	490.0	5.2	650.0	
E	0-5 cm	0.50	0.64	63.3	4.0	158.0	60.0	180.0	760.0	3.7	300.0	1.0
N		5	5	5	5	5	5	5	5	5	5	3
		0.62	0.90	39.83	2.60	134.80	54.00	95.40	346.00	3.54	364.80	1.0
S		0.60	1.00	22.30	0.89	59.39	31.10	58.06	279.19	1.00	191.99	0.0

* STATIONS AS PER FIGURE 11.

CONCLUSIONS

It was concluded that:

1. Metals and other tailings materials have been leached from the Gods Lake Gold Mines' tailings disposal site and have been transported to Gods Lake primarily by one stream.

2. The area of Gods Lake sediments detectably affected by metals emanating from the tailings disposal area may be described as lying southwesterly of the major drainage stream mouth in a band extending from the shoreline to the first seaward reef-island chain. This encompassed approximately 0.05 square kilometres of lake surface.

3. Metal concentrations in sediments of the affected area showed significant increases at an exponential rate over background as the above mentioned stream mouth was approached. Specifically, concentrations at varying distances from the stream may be defined as follows:

$$\mu g/g\ Hg = 3.34\ exp.\ (-3.45\ (km))$$
$$\mu g/g\ As = 22.36\ exp.\ (-2.07\ (km))$$
$$\mu g/g\ Cu = 79.56\ exp.\ (-1.72\ (km))$$
$$\mu g/g\ Pb = 49.03\ exp.\ (-1.53\ (km))$$
$$\mu g/g\ Ni = 70.03\ exp.\ (-1.48\ (km))$$
$$\mu g/g\ Zn = 240.70\ exp.\ (-1.63\ (km))$$
$$\%\ Fe = 6.34\ exp.\ (-1.66\ (km))$$

4. Elevated sediment concentrations of cadmium, manganese and cyanide were not conclusively shown to have originated from leachate of the tailings disposal site.

5. Mercury, arsenic, cadmium, lead and zinc have accumulated at levels greater than background in the body tissues of macroinvertebrates

colonizing affected sediments.

6. The tailings disposal site did not appear to be solely responsible for the elevated arsenic concentrations in the muscle tissue of fish frequenting the north basin of Gods Lake.

7. Fish bioaccumulation of mercury, lead, copper, zinc, nickel and cadmium emanating from the tailings disposal site was not detected.

8. Contamination of the water column by either metals or acid drainage emanating from the tailings disposal site was not detected.

REFERENCES CITED

Davies, J.F., B.B. Bannatyne, G.S. Barry and H.R. McCabe. 1962. Geology and Mineral Resources of Manitoba. Mines Br., Man. Dept. of Mines and Natural Res., Winnipeg.

Fairbridge, R.W., Ed. 1972. The Encyclopedia of Geochemistry and Environmental Sciences. Encyclopedia of Earth Sciences Series, Vol. IV-A. Van Nostrand Reinhold Co., Toronto.

Fedoruk, A.N. 1970. Proposed Watershed Divisions of Manitoba. Rep. #10. Man. Dept. Mines and Natural Resources, Canada Land Inventory Proj., Winnipeg.

Mineral Development Sector, 1962. Gods Lake Gold Mines Ltd. Card #505123. A compendium by Can. Dept. of Energy, Mines and Resources. Ottawa.

RAND Corporation, 1955. A Million Random Digits with 100,000 Normal Deviates. The Free Press of Glencoe. New York.

Schlick, R.O. 1978. A Fisheries Survey of Gods Lake, 1973. Fish. Res. Ms. Rept. No. 78-5. Man. Dept. Renewable Resources and Transportation Services. Winnipeg.

Sorba, E.A., D. Fox and P. Douville. 1980. Analytical Methods, 2nd Ed. Technical Services Laboratory, Man. Dept. of Mines, Natural Resources and Environment. Winnipeg.

Vollenweider, R. A. 1968. Scientific Fundamentals of the Eutrophication of Lakes and Flowing Waters, with Particular Reference to Nitrogen and Phosphorus as Factors in Eutrophication. Organization for Economic Cooperation and Development. Paris.

Weir, T.R. ed. 1960. Economic Atlas of Manitoba. Man. Dept. Industry and Commerce. Winnipeg.

APPENDIX 1 (a): WATER PHYSICOCHEMICAL DATA FOR GODS LAKE BLOCK "A", JUNE 10, 1981.

Parameter \ Station		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Depth	m	7.5	7.75	6.6	7.5	6.8	7.75	5.5	5.2	6.5	6.8	6.0	6.6	6.75	6.5	6.4
Sample Depth	m	2.4	1.7	6.5	6.2	3.7	3.3	2.8	4.1	4.6	0.3	0.6	1.1	6.4	3.6	3.1
Filed Temperature	oC	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Conductivity	umho/cm	130.	135.	135.	132.	137.	135.	135.	135.	135.	132.	129.	134.	135.	135.	132.
Residue Non Filt.	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
pH	Units	7.85	8.00	7.80	7.95	7.82	7.88	7.90	7.80	7.90	7.85	7.85	7.85	7.90	7.90	7.90
Alkalinity Total (C_aCO_3)	mg/l	58.0	58.5	57.5	57.8	58.0	73.0	57.0	57.0	58.0	57.0	57.0	57.0	58.0	58.0	57.5
Alkalinity (HCO_3)	mg/l	71.0	71.0	70.0	70.5	71.0	89.1	69.5	69.5	71.0	69.5	69.5	69.2	70.5	71.0	70.0
Alkalinity (CO_3)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity ((OH)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
As (Tptal)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	<0.001
Cd (Ext.)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ca (Ext.)	mg/l	0.010	0.095	0.020	0.030	0.050	0.060	0.035	0.010	0.020	0.070	0.025	0.015	0.020	0.050	0.020
Pb (Ext.)	mg/l	<0.005	0.005	0.005	0.005	0.005	0.010	0.005	0.005	0.005	0.005	<0.005	<0.005	0.005	0.010	<0.005
Ni (Ext.)	mg/l	<0.005	0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	0.005	0.005	0.005	<0.005
Zn (Ext.) (Dir.)	mg/l	<0.02	0.05	<0.02	<0.02	0.02	0.03	0.02	<0.02	<0.02	0.03	<0.02	<0.02	<0.02	0.09	<0.02
Hg (Ext.)	µg/l	<0.02	<0.02	0.06	<0.02	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	1.20	0.04	<0.02
Ca (Ext.)	mg/l	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	12.0	10.0	10.0	10.0
Mg (Ext.)	mg/l	5.0	4.0	4.1	4.2	4.1	4.2	4.2	4.0	4.2	4.3	4.1	4.2	4.2	4.2	4.2
Dissolved Oxygen	mg/l	10.0	9.90	9.90	9.90	9.90	N/A	10.0	10.0	9.9	10.0	10.0	9.8	9.9	9.9	10.0
T.O.C.	mg/l	10.5	10.0	11.5	11.0	10.5	10.5	11.5	10.0	10.0	11.0	10.0	10.5	10.5	10.0	10.5
T.I.C.	mg/l	13.5	13.0	13.0	13.0	13.5	12.5	13.0	13.0	12.5	13.0	13.0	12.5	13.0	13.0	12.5
Turbidity	NTu	2.0	2.0	2.5	2.0	2.0	2.5	2.5	2.0	2.0	2.5	2.0	2.5	2.5	2.5	2.5
CN (Total) + (Free)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Kjeldhal Total - N	mg/l	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
NO_3- NO_2- N (Diss.)	mg/l	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.04	0.03	<0.01	0.01
P - Total		0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02

APPENDIX 1 (b): WATER PHYSICOCHEMICAL DATA FOR GODS LAKE BLOCK "B", JUNE 14, 1981

Parameter \ Station		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total Depth	m	4.25	8.0	4.0	9.0	2.5	9.5	7.5	3.5	1.5	4.0	7.3	6.0	9.2	5.5	5.8
Sample Depth	m	1.1	7.5	3.3	5.1	2.4	7.4	0.5	2.3	1.5	2.2	6.9	4.4	7.0	0.6	3.4
Field Temperature	oC	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Conductivity	umho/cm	128.	125.	126.	127.	127.	128.	129.	128.	126	126.	129.	126.	129.	128.	128.
Residue Non Filt.	mg/l	6.0	< 5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
pH		8.10	8.05	8.10	8.00	8.05	7.90	7.95	8.10	8.00	8.20	7.85	8.10	8.00	8.05	8.00
Alkalinity Total (C_aCO_3)	mg/l	62.0	61.0	62.0	62.0	61.0	62.0	62.0	62.0	61.0	61.0	62.0	61.0	61.5	61.0	61.0
Alkalinity (HCO_3^-)	mg/l	76.0	74.0	75.0	76.0	74.0	73.0	75.0	75.0	74.0	75.0	76.0	75.0	75.0	74.0	75.0
Alkalinity (CO_3)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity (OH^-)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
As (Total)	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cd (Ext.)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ca (Ext.)	mg/l	0.035	0.010	0.010	0.010	0.075	0.030	0.025	0.020	0.050	0.050	0.015	0.010	0 010	0.005	0.015
Pb (Ext.)	mg/l	0.005	0.005	0.005	0.005	0.005	0.005	0.005	<0.005	0.005	0.010	0.005	<0.005	0.005	0.005	0.005
Ni (Ext.)	mg/l	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	<0.005	0 005	0.005	0.005	<0.005	<0.005	0.005
Zn (Ext.)	mg/l	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	0.03	0.02	0.02	0.02	<0.02	<0.02	<0.02
Hg (Ext.)	µg/l	0.07	<0.02	<0.02	<0.02	0.10	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.18	<0.02
Ca (Ext.)	mg/l	10.0	10.0	10.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	15.0	13.0	15.0
Mg (Ext.)	mg/l	4.2	4.2	4.1	4.3	4.3	4.3	4.3	4.3	4 3	4.3	4.3	4.3	4.3	4.3	4.3
Dissolved Oxygen	mg/l	11.8	11.6	11.9	11.9	11.1	11.9	11.9	11.2	11.2	11.7	11.7	11.7	11.9	11.7	11.7
T.O.C.	mg/l	17.0	11.0	11.5	15.5	13.0	12.5	11.0	12.0	11.0	10.0	11.0	11.0	11.0	10.0	10.5
T.I.C.	mg/l	13.5	13.5	13.5	13.5	13.0	14.0	13.5	14.0	13 5	13.5	14.0	13.5	13.5	13.5	13.5
Turbidity	NTu	1.0	1.0	1.0	1.5	1.5	1.5	1.0	1.5	1.5	1.5	1.5	0.85	1.0	1.5	1.0
CN (Total)+(Free)	mg/l	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02
Kjeldhal Total - N	mg/l	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
NO_3-NO_2-N (Diss.)	mg/l	<0.01	<0 01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
P - Total	mg/l	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	<0.02	0.02

APPENDIX 1 (c): WATER PHYSICOCHEMICAL DATA FOR GODS LAKE BLOCK "C", JUNE 16, 1981

Parameter \ Station		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Total Depth	m	5.0	25.6	16.1	1.8	11.4	8.3	1.1	4.3	11.0	4.0	22.0	10.4	4.4	13.2	4.5
Sample Depth	m	0.1	10.2	12.7	1.1	4.9	0.9	0.4	2.0	0.9	2.2	16.3	1.1	2.8	6.2	1.5
Field Temperature	°C	5.0	5.0	5.0	5.0	5.0	5.0	8.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Conductivity	umho/cm	125.	127.	125.	127.	128.	125	128	127	127	128	128	127	127	128	127
Residue Non Filt.	mg/l	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
pH		7.90	7.85	7.80	7.85	7.90	8.00	8.00	7.95	7.90	7.90	7.90	8.05	7.90	7.80	8.00
Alkalinity Total (C_aCO_3)	mg/l	63.0	63.0	63.0	63.0	62.5	62.5	61.5	63.0	63.0	63.0	64.5	63.0	64.0	62.5	62.0
Alkalinity (HCO_3)	mg/l	77.0	77.0	77.0	77.0	76.0	76.0	75.0	77.0	77.0	77.0	79.0	77.0	78.0	76.0	76.0
Alkalinity (CO_3)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alkalinity (OH^-)	mg/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
As (Total)	mg/l	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.001	<0.001	<0.001	0.002	0.001	0.001
Cd (Ext.)	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ca (Ext.)	mg/l	0.005	0.045	0.005	0.025	0.015	0.015	0.035	0.045	0.050	0.015	0.010	0.035	0.010	0.030	0.020
Pb (Ext.)	mg/l	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Ni (Ext.)	mg/l	0.005	0.005	0.005	<0.005	<0.005	0.005	0.005	<0.005	0.005	<0.005	0.005	0.005	0.005	0.005	0.005
Zn (Ext.)	mg/l	<0.02	0.02	<0.02	0.02	<0.02	<0.02	0.02	0.03	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Hg (Ext.)	µg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ca (Ext.)	mg/l	13.0	13.0	13.0	13.0	17.0	13.0	15.0	13.0	15.0	15.0	15.0	15.0	15.0	15.0	13.0
Mg (Ext.)	mg/l	5.0	4.3	4.3	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.3	4.4	4.4	4.4	4.4
Dissolved Oxygen	mg/l	11.4	11.6	11.3	12.0	11.8	11.6	12.0	11.7	11.8	11.6	11.0	11.5	11.3	11.8	11.8
T.O.C.	mg/l	9.5	10.0	9.0	11.5	10.0	10.0	9.5	12.0	9.5	10.5	10.5	10.5	9.0	9.5	10.5
T.I.C.	mg/l	16.5	14.0	15.5	12.5	13.0	14.0	14.5	11.5	15.5	13.5	13.5	13.5	15.0	14.0	14.5
Turbidity	NTu	0.95	1.50	1.0	1.0	1.50	1.0	1.50	1.50	0.75	1.0	0.90	1.0	0.75	1.0	0.75
CN(Total) + (Free)	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Kjeldhal Total - N	mg/l	0.3	0.3	0.3	0.3	0.3	0.3	0.04	0.3	0.3	0.3	0.3	0.3	0.3	0 3	0.3
NO_3-NO_2- N (Diss.)	mg/l	0.04	0.02	0.01	0.01	0.01	0.01	0.19	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01
P - Total	mg/l	0.02	0.04	0.01	0.03	0.01	0.02	0.02	0.02	0.02	0.01	0.05	0.01	0.02	0.01	0.01

APPENDIX 2(a): CYANIDE AND METAL CONCENTRATIONS* IN GODS LAKE SEDIMENTS, BLOCK "A".

Parameter / Station	Hg (Wet) (µg/g)	Hg (µg/g)	As (µg/g)	Cd (µg/g)	Cu (µg/g)	Pb (µg/g)	Ni (µg/g)	Zn (µg/g)	Fe (%)	Mn (µg/g)	CN (µg/g)
1	<0.02	0.04	4.40	2.0	30.0	18.0	39.0	95.0	2.8	575	-
2	<0.02	0.05	4.40	2.0	30.0	25.0	39.0	95.0	2.8	500	
3	<0.02	0.03	4.40	2.0	29.0	20.0	39.0	90.0	2.8	525	-
4	<0.02	0.03	4.30	1.0	28.0	20.0	35.0	90.0	2.6	450	-
5	<0.02	0.02	4.40	1.0	30.0	20.0	43.0	95.0	3.0	575	<1.0
6	<0.02	0.03	3.60	1.0	30.0	20.0	43.0	95.0	2.6	425	
7	<0.02	0.03	4.97	1.0	33.0	20.0	39.0	95.0	3.0	625	-
8	<0.02	0.02	<1.23	<1.0	6.0	<5.0	10.0	18.0	0.65	125	-
9	<0.02	0.02	4.73	2.0	31.0	20.0	43.0	95.0	2.8	600	-
10	<0.02	0.03	5.50	2.0	29.0	18.0	39.0	95.0	2.6	725	<1.0
11	<0.02	0.02	5.43	2.0	30.0	18.0	43.0	95.0	2.9	700	-
12	<0.02	0.02	4.53	2.0	30.0	18.0	43.0	95.0	3.0	600	-
13	<0.02	<0.02	4.07	2.0	31.0	20.0	43.0	95.0	2.8	550	-
14	<0.02	<0.02	1.98	<1.0	7.0	10.0	14.0	24.0	0.9	224	-
15	0.02	0.06	4.53	1.0	31.0	25.0	39.0	95.0	3.1	575	<1.0

* DATA BASED ON DRY WEIGHT OF SAMPLE EXCEPT WHERE INDICATED

APPENDIX 2(b): CYANIDE AND METAL CONCENTRATIONS* IN GODS LAKE SEDIMENTS, BLOCK "B".

Parameter / Station	Hg (Wet) (µg/g)	Hg (µg/g)	As (µg/g)	Cd (µg/g)	Cu (µg/g)	Pb (µg/g)	Ni (µg/g)	Zn (µg/g	Fe (%)	Mn (µg/g)	CN (µg/g)
16	<0.02	<0.02	1.55	<1.0	10.0	13.0	8.0	18.0	0.50	92.	-
17	<0.02	<0.02	1.53	1.0	5.0	5.0	8.0	17.0	0.50	60	-
18	<0.02	<0.02	1.73	2.0	5.0	5.0	10.0	18.0	0.70	86.	-
19	<0.02	<0.02	1.00	<1.0	4.0	<5.0	8.0	13.0	0.45	53.	-
20	<0.02	<0.02	1.50	<1.0	3.0	<5.0	8.0	9.0	0.40	78	<1.0
21	<0.02	<0.02	1.16	1.0	6.0	<5.0	8.0	20.0	0.65	88.	-
22	<0.02	<0.02	1.27	1.0	5.0	<5.0	8.0	14.0	0.50	83.	-
23	<0.02	<0.02	1.18	1.0	4.0	<5.0	8.0	16.0	0.45	62.	-
24	<0.02	<0.02	1.13	<1.0	5.0	<5.0	5.0	10.0	0.40	48.	-
25	<0.02	<0.02	0.98	<1.0	5.0	<5.0	8.0	15.0	0.45	88.	<1.0
26	<0.02	<0.02	0.89	<1.0	4.0	<5.0	8.0	14.0	0.45	65.	-
27	<0.02	<0.02	0.92	1.0	5.0	5.0	10.0	17.0	0.60	70.	-
28	<0.02	0.02	1.03	1.0	6.0	5.0	10.0	19.0	0.50	72.	-
29	<0.02	<0.02	1.35	<1.0	4.0	5.0	8.0	14.0	0.70	125.	-
30	<0.02	<0.02	0.70	<1.0	3.0	5.0	8.0	8.0	0.25	35.	-

*DATA BASED ON DRY WEIGHT OF SAMPLE EXCEPT WHERE INDICATED.

APPENDIX 2(b): CYANIDE AND METAL CONCENTRATIONS* IN GODS LAKE SEDIMENTS, BLOCK "C".

Parameter / Station	Hg(Wet) (µg/g)	Hg(Dry) (µg/g)	As (µg/g)	Cd (µg/g)	Cu (µg/g)	Pu (µg/g)	Ni (µg/g)	Zn (µg/g)	Fe (%)	Mn (µg/g)	CN (µg/g)
31	<0.02	0.02	2.79	1.0	7.0	10.0	8.0	24.0	0.60	11.0	-
32	-	-	-	-	-	-	-	-	-	-	-
33	0.04	0.09	1.81	1.0	13.0	13.0	17.0	39.0	1.00	155.0	-
34	0.10	0.32	3.28	1.0	26.0	20.0	20.0	46.0	0.90	128.0	-
35	0.02	0.03	3.85	1.0	17.0	10.0	14.0	24.0	1.80	275.0	2.5
36	0.02	0.03	1.24	1.0	6.0	5.0	10.0	30.0	0.65	70.0	-
37	0.16	0.57	22.70	2.0	115.0	40.0	39.0	190.0	2.50	177.0	-
38	0.02	0.03	1.25	1.0	8.0	5.0	8.0	23.0	0.55	69.0	-
39	-	-	-	-	-	-	-	-	-	-	-
40	0.77	1.57	7.32	3.0	28.0	30.0	100.0	210.0	8.80	5300.0	8.1
41	-	-	27.2	3.0	139.0	80.0	27.0	280.0	2.80	325.0	-
42	-	-	2.63	1.0	12.0	10.0	10.0	39.0	1.00	140.0	-
43	-	-	1.58	1.0	10.0	5.0	14.0	30.0	0.65	80.0	-
44	-	-	1.00	2.0	5.0	< 5.0	10.0	12.0	0.55	78.0	-
45	0.02	0.02	1.24	2.0	7.0	5.0	8.0	20.0	0.55	98.0	7.0
46	-	-	41.3	2.0	138.0	50.0	39.0	200.0	3.60	250.0	-

* DATA BASED ON DRY WEIGHT OF SAMPLE EXCEPT WHERE INDICATED

APPENDIX 3: NET SET RESULTS

Sampling Block	Lift Date	Species Nets	Northern Pike	Lake Whitefish	Walleye	Common Sucker	Longnose Sucker	Cisco	Lake Trout
A	810611 (24 hrs)	137m X 95mm mesh X 4.9m deep 137m X 108mm mesh X 3.7m deep 91.4m X 127mm mesh X 1.8m deep	137	7	119	100	14	15	0
B	810613 (24 hrs)	45.7m X 95mm mesh X 4.9m deep 45.7m X 108mm mesh X 3.7m deep 91.4m X 127mm mesh X 1.8m deep	24	25	8	5	146	1	0
$C_{(a)}$	810615 (24 hrs)	91.4m X 95mm mesh X 4.9m deep 91.4m X 108mm mesh X 3.7m deep	31	22	5	17	22	6	8
$C_{(b)}$	810616 (12 hrs)	As $C_{(a)}$	19	7	10	4	9	4	2
TOTALS	-	- -	211	61	142	126	191	26	10

APPENDIX 4(a-1): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, NORTHERN PIKE AT BLOCK "A"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
1	65.0	2080	M	10	0.20	C.02	<0.5	0.1	4.8	<0.5	<0.1
2	75.3	2500	F	8	0.23	C.02	<0.5	<0.1	5.5	<0.5	<0.1
3	70.1	2220	M	8	0.24	<0.02	<0.5	0.2	6.1	<0.5	<0.1
4	65.5	2000	M	10	0.30	<0.02	<0.5	0.1	6.3	<0.5	<0.1
5	66.4	1960	F	7	0.17	<0.02	<0.5	0.1	5.5	<0.5	<0.1
6	69.6	2300	F	11	0.31	0.02	<0.5	0.1	5.5	<0.5	<0.1
7	64.3	1620	F	7	0.24	<0.02	<0.5	0.1	5.5	<0.5	<0.1
8	67.8	1980	F	12	0.24	<0.02	<0.5	0.2	6.9	<0.5	<0.1
9	82.5	4100	F	9	0.41	0.02	<0.5	0.1	6.4	<0.5	<0.1
10	75.6	3480	M	13	0.36	0.02	<0.5	0.2	5.8	<0.5	<0.1
11	77.8	2100	M	10	0.47	0.02	<0.5	0.1	7.8	<0.5	<0.1
12	71.5	2740	F	8	0.29	0.02	0.5	<0.1	9.0	<0.5	<0.1
13	73.4	2360	F	11	0.38	0.02	0.5	<0.1	6.6	<0.5	<0.1
14	70.1	2400	F	8	0.38	0.03	0.5	<0.1	6.6	<0.5	<0.1
15	65.7	1990	M	9	0.28	0.03	0.8	0.5	8.0	<0.5	<0.1
16	92.0	5830	F	13	0.37	0.02	0.8	<0.1	9.0	<0.5	<0.1
17	84.3	4100	F	12	0.32	0.03	0.5	<0.1	5.6	<0.5	<0.1
18	55.5	1340	M	7	0.13	<0.02	0.5	0.3	6.6	<0.5	0.1
19	64.0	2040	M	8	0.17	0.03	0.5	<0.1	5.6	<0.5	<0.1
20	88.0	5700	F	15	0.51	0.03	0.5	0.1	7.4	<0.5	<0.1

APPENDIX 4(a-2): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, NORTHERN PIKE AT BLOCK "B"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
161	65.9	1690	F	10	0.19	0.04	<0.5	0.5	4.8	<0.5	<0.1
162	65.0	2330	M	9	0.13	0.04	<0.5	0.5	3.2	<0.5	<0.1
163	69.0	2450	F	8	0.16	0.03	<0.5	0.2	3.3	<0.5	<0.1
164	63.8	1910	M	9	0.33	0.03	<0.5	0.9	4.6	0.5	<0.1
165	52.5	1160	M	5	0.10	0.03	<0.5	0.9	4.9	<0.5	<0.1
166	63.8	2340	M	8	0.19	0.03	<0.5	0.2	5.6	1.0	<0.1
167	64.1	2100	M	9	0.19	0.05	<0.5	0.2	3.2	<0.5	<0.1
168	61.6	1840	F	8	0.21	0.04	<0.5	0.5	5.8	<0.5	<0.1
169	68.9	2940	F	9	0.39	0.09	<0.5	0.2	5.8	<0.5	<0.1
170	57.0	1240	F	6	0.23	0.06	<0.5	0.5	4.1	<0.5	<0.1
171	58.1	1520	F	6	0.24	0.03	<0.5	0.2	4.8	<0.5	<0.1
172	73.5	2960	F	13	1.13	0.14	<0.5	0.7	4.9	1.4	<0.1
173	67.8	1970	F	9	0.38	0.07	<0.5	0.2	4.8	<0.5	<0.1
174	65.3	1830	F	9	0.25	0.05	<0.5	0.5	5.6	<0.5	<0.1
175	64.2	1770	F	6	0.17	0.03	<0.5	0.1	4.1	<0.5	<0.1
176	65.8	2120	F	9	0.16	0.04	<0.5	0.2	3.2	0.5	<0.1
177	74.5	3020	F	12	0.27	0.08	<0.5	0.2	3.0	<0.5	<0.1
178	58.2	1300	M	6	0.18	0.05	<0.5	0.1	4.1	<0.5	<0.1
179	63.3	1740	F	10	0.25	0.05	<0.5	0.2	3.8	<0.5	<0.1
180	70.6	2580	F	7	0.08	0.06	<0.5	0.2	3.6	<0.5	<0.1

APPENDIX 4(a-3): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, NORTHERN PIKE AT BLOCK "C"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
81	64.5	1860	F	9	0.40	0.04	<0.5	0.3	5.2	<0.5	<0.1
82	58.9	1450	M	8	0.23	0.03	<0.5	0.3	4.2	<0.5	<0.1
83	53.5	1000	F	5	0.17	0.03	<0.5	0.5	3.8	<0.5	<0.1
84	62.9	1840	F	7	0.22	0.03	<0.5	0.7	3.6	<0.5	<0.1
85	55.2	1200	F	6	0.24	0.02	<0.5	0.7	4.2	<0.5	<0.1
86	64.4	1940	F	7	0.28	0.04	<0.5	<0.1	3.4	<0.5	<0.1
87	60.5	1330	F	7	0.35	0.04	<0.5	0.7	8.4	<0.5	<0.1
88	59.6	1470	F	7	0.31	0.03	<0.5	0.3	3.8	<0.5	<0.1
89	59.7	1480	F	6	0.24	0.03	<0.5	0.5	6.6	<0.5	<0.1
90	61.2	1640	F	6	0.19	0.06	<0.5	0.5	3.8	0.5	<0.1
91	72.2	2550	F	9	0.38	0.04	0.5	0.9	4.2	<0.5	<0.1
92	53.1	1080	F	5	0.30	0.02	0.8	0.3	4.4	<0.5	<0.1
93	75.9	3240	F	10	0.52	0.09	<0.5	0.6	5.0	<0.5	<0.1
94	57.4	1440	M	9	0.25	0.03	<0.5	0.3	3.4	<0.5	<0.1
95	67.6	2140	F	11	0.36	0.07	<0.5	0.3	3.6	<0.5	<0.1
96	64.3	1980	F	7	0.20	0.06	<0.5	0.3	3.2	<0.5	<0.1
97	61.6	1600	F	9	0.28	0.04	<0.5	0.8	6.6	<0.5	<0.1
98	60.3	1440	F	5	0.24	0.03	<0.5	0.6	5.2	<0.5	<0.1
99	52.2	940	M	6	0.11	0.04	<0.5	0.6	3.6	<0.5	<0.1
100	50.1	900	M	5	0.18	<0.02	<0.5	0.3	4.8	<0.5	<0.1

APPENDIX 4(b-1): GENERAL MENSTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, LAKE WHITEFISH AT BLOCK "A"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Musole Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
41	45.1	1200	F	14	0.09	0.04	<0.5	0.8	6.6	<0.5	<0.1
42	33.7	1130	M	13	0.04	0.02	<0.5	0.5	5.8	<0.5	<0.1
43	50.4	1470	F	25	0.07	0.08	0.5	0.1	7.4	<0.5	<0.1
44	49.6	1520	M	15	0.05	0.03	<0.5	0.1	4.8	<0.5	<0.1
45	48.7	1580	F	17	0.10	0.03	<0.5	0.1	4.8	<0.5	<0.1
46	45.6	1110	M	20	0.06	0.04	<0.5	0.2	5.8	<0.5	0.1
47	35.2	670	M	11	0.03	0.03	<0.5	0.2	4.8	<0.5	<0.1

APPENDIX 4(b-2): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, LAKE WHITEFISH AT BLOCK "B".

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
201	49.2	1300	F	19	0.17	0.05	<0.5	0.2	4.0	<0.5	<0.1
202	46.8	1360	M	15	0.05	0.05	<0.5	0.2	5.1	<0.5	<0.1
203	41.6	960	M	12	0.04	0.06	<0.5	0.2	4.0	<0.5	<0.1
204	44.8	1330	M	15	0.03	0.04	<0.5	0.1	5.3	<0.5	<0.1
205	45.1	1220	M	15	0.10	0.03	<0.5	0.1	4.2	<0.5	<0.1
206	43.6	1160	F	19	0.04	0.09	<0.5	0.2	3.3	<0.5	<0.1
207	38.8	850	F	13	0.06	0.16	<0.5	0.1	3.6	<0.5	<0.1
208	45.5	1300	M	13	0.14	0.03	<0.5	0.1	4.2	<0.5	<0.1
209	43.5	1170	M	9	0.05	0.05	<0.5	0.1	4.2	<0.5	<0.1
210	43.1	1080	M	9	0.17	0.04	0.5	<0.1	4.1	<0.5	<0.1
211	43.8	1340	F	15	0.05	0.09	<0.5	0.5	4.6	<0.5	<0.1
212	49.3	1650	F	17	0.09	0.08	<0.5	0.1	3.7	<0.5	<0.1
213	40.8	1900	F	9	0.06	0.03	<0.5	0.2	4.5	0.5	<0.1
214	55.0	2220	M	19	0.15	0.02	0.5	0.1	3.6	<0.5	<0.1
215	44.8	1190	F	10	0.09	0.11	<0.5	0.2	4.6	<0.5	<0.1
216	49.0	1530	M	21	0.09	0.04	<0.5	0.1	3.3	<0.5	<0.1
217	42.6	1120	M	12	0.20	0.09	<0.5	0.1	5.3	<0.5	<0.1
218	43.7	1120	F	12	0.07	0.03	<0.5	<0.1	3.3	<0.5	<0.1
219	48.6	1560	M	15	0.10	0.05	<0.5	0.1	3.7	<0.5	<0.1
220	44.2	1140	?	13	0.17	0.07	<0.5	0.5	6.3	<0.5	<0.1

APPENDIX 4(b-3): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, LAKE WHITEFISH AT BLOCK "C"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
121	45.4	1180	M	14	0.26	0.06	<0.5	0.1	3.3	<0.5	<0.1
122	38.3	790	M	10	0.05	0.07	<0.5	0.1	5.4	0.5	<0.1
123	46.6	1390	F	12	0.10	0.06	<0.5	0.1	3.9	<0.5	<0.1
124	44.4	1140	F	19	0.10	0.05	<0.5	0.1	3.0	<0.5	<0.1
125	41.5	1160	F	11	0.16	0.07	<0.5	0.1	5.1	<0.5	<0.1
126	45.6	1270	F	15	0.13	0.04	<0.5	0.1	3.3	<0.5	<0.1
127	41.9	900	F	13	0.08	0.06	<0.5	0.1	3.3	<0.5	<0.1
128	48.3	1400	F	23	0.09	0.06	<0.5	0.1	3.6	<0.5	<0.1
129	45.1	1160	F	12	0.26	0.03	<0.5	0.1	3.6	<0.5	<0.1
130	44.0	1240	M	16	0.08	0.19	<0.5	<0.1	3.3	<0.5	<0.1
131	36.9	660	M	12	0.05	0.09	<0.5	0.1	3.3	<0.5	<0.1
132	40.8	1020	F	11	0.09	0.08	<0.5	<0.1	4.8	0.5	<0.1
133	39.3	760	M	10	0.09	0.13	<0.5	<0.1	4.8	<0.5	<0.1
134	38.3	710	M	12	0.03	0.10	<0.5	<0.1	3.0	<0.5	<0.1
135	37.2	730	F	11	0.07	0.12	<0.5	0.5	3.6	<0.5	<0.1
136	40.8	930	M	10	0.10	0.13	<0.5	0.2	3.9	<0.5	<0.1
137	44.0	1180	M	14	0.10	0.07	<0.5	0.1	3.9	<0.5	<0.1
138	43.0	1030	M	13	0.16	0.04	<0.5	0.1	3.6	<0.5	<0.1
139	37.5	740	M	9	0.08	0.05	<0.5	0.2	4.5	<0.5	<0.1
140	36.3	640	F	9	0.07	0.03	<0.5	0.5	3.9	<0.5	<0.1

APPENDIX 4(c-1): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, WALLEYE AT BLOCK "A"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
21	48.4	1280	M	11	0.10	0.03	<0.5	<0.1	7.0	0.5	<0.1
22	39.4	710	F	11	0.13	<0.02	<0.5	0.3	5.6	0.5	<0.1
23	48.1	1160	F	15	0.31	0.05	<0.5	<0.1	5.2	0.5	<0.1
24	45.5	1100	F	11	0.14	0.02	0.8	0.6	7.4	0.5	<0.1
25	53.0	1490	F	18	0.29	0.02	<0.5	<0.1	5.8	0.5	<0.1
26	44.0	960	M	18	0.22	0.04	<0.5	0.6	7.4	0.5	<0.1
27	37.0	530	M	11	0.13	0.03	<0.5	0.1	5.8	0.5	<0.1
28	40.6	810	F	11	0.14	0.02	<0.5	0.1	5.2	0.5	<0.1
29	37.6	520	M	9	0.17	0.02	<0.5	<0.1	6.4	0.5	<0.1
30	46.5	1150	F	11	0.15	0.02	<0.5	0.1	6.4	0.5	<0.1
31	44.8	980	F	10	0.13	0.02	0.8	<0.1	5.2	0.5	<0.1
32	49.5	1360	F	11	0.16	0.02	<0.5	0.3	5.2	0.5	<0.1
33	38.2	610	M	11	0.16	0.03	<0.5	0.3	6.4	0.5	<0.1
34	46.1	1220	F	11	0.16	0.02	<0.5	<0.1	4.8	0.5	<0.1
35	41.4	830	F	11	0.13	0.02	<0.5	<0.1	5.2	0.5	<0.1
36	39.5	660	F	7	0.10	0.02	<0.5	<0.1	5.2	0.5	<0.1
37	47.2	1170	F	16	0.30	0.04	<0.5	0.1	6.4	0.5	<0.1
38	39.9	730	F	13	0.17	0.03	<0.5	0.1	5.2	0.5	<0.1
39	51.1	1700	M	16	0.22	0.04	<0.5	0.1	6.8	0.5	<0.1
40	47.2	1220	M	15	0.32	0.03	<0.5	0.8	4.4	0.5	<0.1

APPENDIX (o-2): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, WALLEYE AT BLOCK "B"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
181	47.4	1120	M	18	0.04	0.06	<0.5	0.2	4.1	<0.5	<0.1
182	50.4	1370	F	21	0.65	0.04	<0.5	0.1	4.1	1.0	<0.1
183	53.7	1580	F	22	0.50	0.07	<0.5	0.1	4.1	<0.5	<0.1
184	53.2	1630	F	15	0.33	0.09	<0.5	0.2	4.8	<0.5	<0.1
185	48.2	1300	F	18	0.39	0.06	<0.5	<0.1	3.2	<0.5	<0.1
186	53.5	1350	M	29	0.70	0.06	<0.5	0.1	5.9	<0.5	<0.1
187	50.7	1300	F	17	0.39	0.04	1.0	0.1	4.0	<0.5	<0.1
188	54.7	1930	F	17	0.46	0.05	<0.5	0.5	7.3	1.0	<0.1

APPENDIX 4(c-3): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, WALLEYE AT BLOCK "C".

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
101	45.8	1110	F	22	0.25	0.03	<0.5	0.2	3.6	1.0	<0.1
102	39.3	690	F	10	0.11	0.05	0.5	<0.1	3.0	0.5	<0.1
103	40.3	740	F	12	0.25	0.05	<0.5	0.1	3.6	<0.5	<0.1
104	39.5	630	F	9	0.19	0.05	<0.5	<0.1	4.2	<0.5	<0.1
105	40.7	840	F	11	0.27	0.04	<0.5	0.1	3.6	<0.5	<0.1
106	38.8	720	F	11	0.22	0.05	<0.5	<0.1	4.2	<0.5	<0.1
107	43.7	920	F	11	0.21	0.04	0.5	<0.1	4.2	<0.5	<0.1
108	39.0	660	M	11	0.22	0.06	<0.5	<0.1	3.0	<0.5	<0.1
109	36.1	520	M	8	0.14	0.06	<0.5	<0.1	3.0	<0.5	<0.1
110	42.3	900	F	11	0.16	0.05	<0.5	0.1	3.3	<0.5	<0.1
111	41.7	870	F	11	0.20	0.07	<0.5	<0.1	3.3	<0.5	<0.1
112	39.8	840	F	11	0.19	0.04	<0.5	0.1	4.2	<0.5	<0.1
113	40.6	860	F	8	0.13	0.05	<0.5	<0.1	4.5	<0.5	<0.1
114	41.2	820	F	11	0.24	0.06	<0.5	0.2	3.6	0.5	<0.1
115	45.5	1180	F	11	0.25	0.09	<0.5	<0.1	4.5	<0.5	<0.1

APPENDIX 4(d-1): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, COMMON SUCKER AT BLOCK "A"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
61	47.4	1640	F	15	0.07	<0.02	<0.5	0.8	5.8	<0.5	<0.1
62	39.3	930	M	13	0.08	0.02	<0.5	0.5	7.2	<0.5	<0.1
63	48.3	1800	F	16	0.06	<0.02	<0.5	0.1	5.2	<0.5	<0.1
64	45.0	1430	F	12	0.07	<0.02	<0.5	0.3	2.6	1.8	<0.1
65	40.8	1260	F	10	0.03	<0.02	<0.5	0.3	3.2	0.5	<0.1
66	40.7	1140	M	10	0.04	0.02	<0.5	0.6	4.2	0.5	<0.1
67	38.8	870	F	9	0.04	0.03	<0.5	0.3	3.6	<0.5	<0.1
68	45.5	1260	F	14	0.05	0.03	<0.5	0.5	2.8	<0.5	<0.1
69	44.3	1260	F	11	0.06	<0.02	<0.5	0.6	4.2	<0.5	<0.1
70	44.0	1480	F	13	0.07	0.06	<0.5	0.6	3.6	<0.5	<0.1
71	45.2	1300	F	10	0.08	0.02	<0.5	0.5	3.6	<0.5	<0.1
72	47.3	1600	F	12	0.10	0.03	<0.5	0.3	3.4	<0.5	<0.1
73	42.6	1260	F	12	0.07	0.03	<0.5	0.3	2.6	<0.5	<0.1
74	41.9	1260	F	12	0.06	<0.02	<0.5	0.6	4.0	<0.5	<0.1
75	33.6	610	F	5	0.03	0.03	<0.5	0.3	2.6	<0.5	<0.1
76	42.8	1280	F	10	0.05	0.02	<0.5	0.3	3.2	<0.5	<0.1
77	47.4	1450	F	12	0.04	0.03	<0.5	0.3	2.6	<0.5	<0.1
78	43.5	1220	F	10	0.05	<0.02	<0.5	0.5	3.2	0.5	<0.1
79	40.0	890	M	10	0.04	0.03	<0.5	0.7	4.2	<0.5	<0.1
80	40.2	1020	M	10	0.03	0.02	<0.5	0.3	2.6	<0.5	<0.1

APPENDIX 4(d-2): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, COMMON SUCKER AT BLOCK "C"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
141	45.9	1440	M	12	0.32	0.03	<0.5	0.2	3.3	<0.5	<0.1
142	44.1	1300	M	13	0.27	0.04	<0.5	0.2	3.6	<0.5	<0.1
143	44.9	1280	M	17	0.29	0.05	<0.5	0.1	5.7	<0.5	<0.1
144	35.8	660	M	6	0.05	0.08	<0.5	0.2	4.5	<0.5	<0.1
145	38.5	820	M	7	0.07	0.04	<0.5	0.2	5.2	<0.5	<0.1
146	41.8	1180	F	8	0.06	0.06	<0.5	0.1	5.5	<0.5	<0.1
147	40.0	960	F	9	0.08	0.02	<0.5	0.1	4.1	<0.5	<0.1
148	47.0	1530	M	14	0.27	0.03	0.5	0.5	6.3	0.5	<0.1
149	37.2	820	F	7	0.04	0.05	<0.5	0.2	6.0	<0.5	<0.1
150	47.2	1430	M	16	0.20	0.09	<0.5	0.1	4.7	<0.5	<0.1
151	42.6	1330	F	9	0.20	0.04	<0.5	0.2	5.7	<0.5	<0.1
152	36.2	740	F	5	0.24	0.04	<0.5	0.1	6.6	<0.5	<0.1
153	43.2	1180	M	15	0.24	0.05	<0.5	0.1	4.1	<0.5	<0.1
154	44.3	1590	F	10	0.12	0.05	<0.5	0.1	4.5	<0.5	<0.1
155	39.0	1000	F	7	0.07	0.06	<0.5	0.1	4.3	<0.5	<0.1
156	47.2	1410	F	14	0.29	0.06	<0.5	0.1	6.2	<0.5	<0.1
157	37.4	780	M	10	0.35	0.04	<0.5	0.2	4.3	<0.5	<0.1
158	37.7	900	M	6	0.06	0.07	<0.5	0.2	4.1	<0.5	<0.1
159	40.4	1000	F	8	0.08	0.08	<0.5	0.2	5.3	<0.5	<0.1
160	42.3	1270	F	16	0.14	0.07	<0.5	0.2	5.5	<0.5	<0.1

APPENDIX 4(e-1): GENERAL MERISTICS AND MUSCLE TISSUE METAL CONCENTRATIONS, LONGNOSE SUCKER AT BLOCK "B"

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
221	50.2	1760	F	14	0.12	0.10	<0.5	0.9	5.9	<0.5	<0.1
222	48.5	1790	F	15	0.04	0.04	<0.5	0.1	3.0	<0.5	<0.1
223	48.0	1580	F	15	0.06	0.04	<0.5	0.2	3.5	<0.5	<0.1
224	44.2	1280	M	15	0.12	<0.02	<0.5	0.2	4.4	<0.5	<0.1
225	46.6	1490	F	13	0.03	0.13	<0.5	0.5	5.7	<0.5	<0.1
226	48.8	1630	M	17	0.11	0.06	<0.5	0.2	3.5	<0.5	<0.1
227	41.3	1160	F	14	0.07	0.08	<0.5	0.1	3.5	<0.5	<0.1
228	49.4	1780	F	17	0.10	0.04	<0.5	0.2	3.4	<0.5	<0.1
229	45.0	1300	M	15	0.06	0.06	<0.5	0.7	6.5	<0.5	<0.1
230	50.5	1610	M	15	0.19	0.03	<0.5	0.5	4.2	<0.5	<0.1
231	44.8	1330	F	11	0.06	0.05	<0.5	0.2	3.5	<0.5	<0.1
232	50.0	2010	F	20	0.07	0.06	<0.5	0.1	2.9	<0.5	<0.1
233	51.3	1980	F	15	0.10	0.03	<0.5	0.1	5.8	1.5	<0.1
234	46.6	1580	F	12	0.08	0.04	<0.5	0.6	4.8	<0.5	<0.1
235	56.4	2440	F	18	0.21	0.09	<0.5	0.2	4.1	<0.5	<0.1
236	43.5	1360	M	12	0.05	0.10	<0.5	0.1	3.1	<0.5	<0.1
237	41.8	1100	F	11	0.07	0.19	<0.5	0.1	3.7	<0.5	<0.1
238	44.0	1260	Immature	15	0.06	0.18	<0.5	0.2	3.6	<0.5	<0.1
239	45.8	1470	M	13	0.14	0.03	<0.5	0.2	4.6	<0.5	<0.1
240	47.1	1700	M	13	0.10	0.05	<0.5	0.2	6.6	<0.5	<0.1

APPENDIX 4(e-2): GENERAL .... CONCENTRATIONS, LONGNOSE SUCKER AT BLOCK "C".

Number	Length (cm)	Weight (g)	Sex	Age (Yrs)	Muscle Tissue Metal Levels (µg/g)						
					Hg	As	Pb	Cu	Zn	Ni	Cd
241	46.6	1550	M	11	0.07	0.08	<0.5	0.2	4.1	<0.5	<0.1
242	41.5	1080	Immature	11	0.05	0.23	<0.5	0.2	3.8	<0.5	<0.1
243	41.9	1030	F	13	0.06	0.09	<0.5	0.2	4.9	<0.5	<0.1
244	44.7	1190	Immature	11	0.05	0.08	<0.5	0.7	8.3	<0.5	<0.1
245	40.1	1000	Immature	10	0.05	0.08	<0.5	0.2	5.3	<0.5	<0.1
246	50.4	2000	F	15	0.17	0.03	<0.5	0.2	6.6	<0.5	<0.1
247	47.0	1630	M	15	0.11	0.02	0.5	0.5	4.5	<0.5	<0.1
248	41.6	1110	Immature	11	0.05	0.14	<0.5	0.2	4.0	<0.5	<0.1
249	48.0	1990	F	13	0.12	0.09	<0.5	0.2	4.3	<0.5	<0.1
250	44.2	1280	F	15	0.06	0.18	<0.5	0.5	7.1	<0.5	<0.1
251	53.2	2360	F	18	0.26	0.05	<0.5	0.5	6.6	0.5	<0.1
252	47.6	1500	M	14	0.09	0.07	<0.5	0.2	4.5	<0.5	<0.1
253	52.0	1750	M	19	0.26	0.08	<0.5	0.1	3.8	<0.5	<0.1
254	44.6	1330	M	12	0.06	0.16	<0.5	0.2	4.3	<0.5	<0.1
255	40.9	1040	M	11	0.06	0.16	0.5	0.2	4.3	<0.5	<0.1
256	51.3	1790	F	16	0.19	0.08	<0.5	0.2	4.5	<0.5	<0.1
257	48.0	1600	M	12	0.06	0.05	0.5	0.5	5.5	<0.5	<0.1
258	46.3	1410	M	14	0.08	0.05	1.0	0.2	3.6	<0.5	<0.1
259	40.6	1010	Immature	12	0.06	0.11	<0.5	0.1	4.7	<0.5	<0.1
260	40.9	910	Immature	14	0.05	0.12	<0.5	0.1	4.5	<0.5	<0.1